9 BASINS Utilities

Additional BASINS utilities have been developed to assist with other necessary functions, such as reclassifying, overlaying, and updating data. These tools and their functions are described below.

Land Use, Soils Class and Overlay: This utility is used to combine land use and soils themes for creating unique land-soil segments within each subwatershed. *Land Use Reclassification*: This tool is used to change land use classifications within an existing data set. Reclassification allows the user to update land use data to evaluate the effect of land use changes on water quality. *Water Quality Observation Data Management*: This tool is used to manage water quality data by allowing the user to add new stations, delete unnecessary stations, relocate misplaced stations, and incorporate new data into existing stations. *DEM Reclassification*: This utility is used to tailor the display of the topographical data.

9.1 Land Use, Soils Class and Overlay

The BASINS *Land Use, Soil Classification and Overlay* tool consists of two items in the *Utilities* menu of the *Basins View*. Both items represent steps in the process of running SWAT from BASINS. While not necessary steps for running HSPF, these tools can be useful for assessing land use and soil distributions within subwatersheds.

The *Land Use and Soil Definition* option allows the user to load land use and soil themes into the current project and determine the land use soil class combinations and distributions for the delineated watershed(s) and each respective sub-watershed. The themes can be either grid or shape format.

The *HRUs Distribution* option in the *Utilities* menu allows the user to specify criteria to be used in determining the HRU distribution. One or more unique land use/soil combinations (hydrologic response units or HRUs) can be created for each subbasin. Although not directly used by *HSPF*, the HRUs can be used to assess the varying hydrologic conditions between sub-watersheds.

9.1.1 Land Use and Soil Definition

Purpose

The *BASINS Land Use and Soil Classification and Overlay* tool allows you to load in the project the land use and soil themes and determine the land use soil class combinations and distributions for the delineated watershed(s) and each respective sub-watershed. The themes can be either grid (with the same projection) or shape theme(s) (even unprojected).

Application

Hydrologic models like **SWAT** and **HSPF** require land use and soil data to determine the area and the hydrologic parameters of each land-soil category simulated within each sub-watershed. The *Land Use and Soil Classification* tool guides the user through the process of specifying the data to be used either shape or grid format. Shape files are automatically converted to grid, the format required by Spatial Analyst to compute cross tabulated areas between land use and soil data sets. Once the application is finished a detailed report is added to the current project. This report describes the landuse and soil class distribution within the watershed and within each sub-watershed unit (subbasin). As with the manual delineation tool, watershed analysis can be performed on delineated watersheds using the BASINS *Watershed Characterization Report* tools. Sample reports include landuse distribution, point sources (PCS), water quality data, toxic chemical releases (TRI), soil distribution (STATSGO), and elevation (DEM). The tool requires Spatial Analyst (ver. 1.1 or later) and Dialog Designer (ver. 3.1 or later) ArcView extensions installed on your PC.

Key Procedures

- Select the model to be used (**HSPF** or **SWAT**)
- Define the land use theme
- Reclassify the land use theme

- Define the soil theme
- Reclassify the soil theme
- Overlay land use and soil themes
- Click the Exit button

Detailed Operations

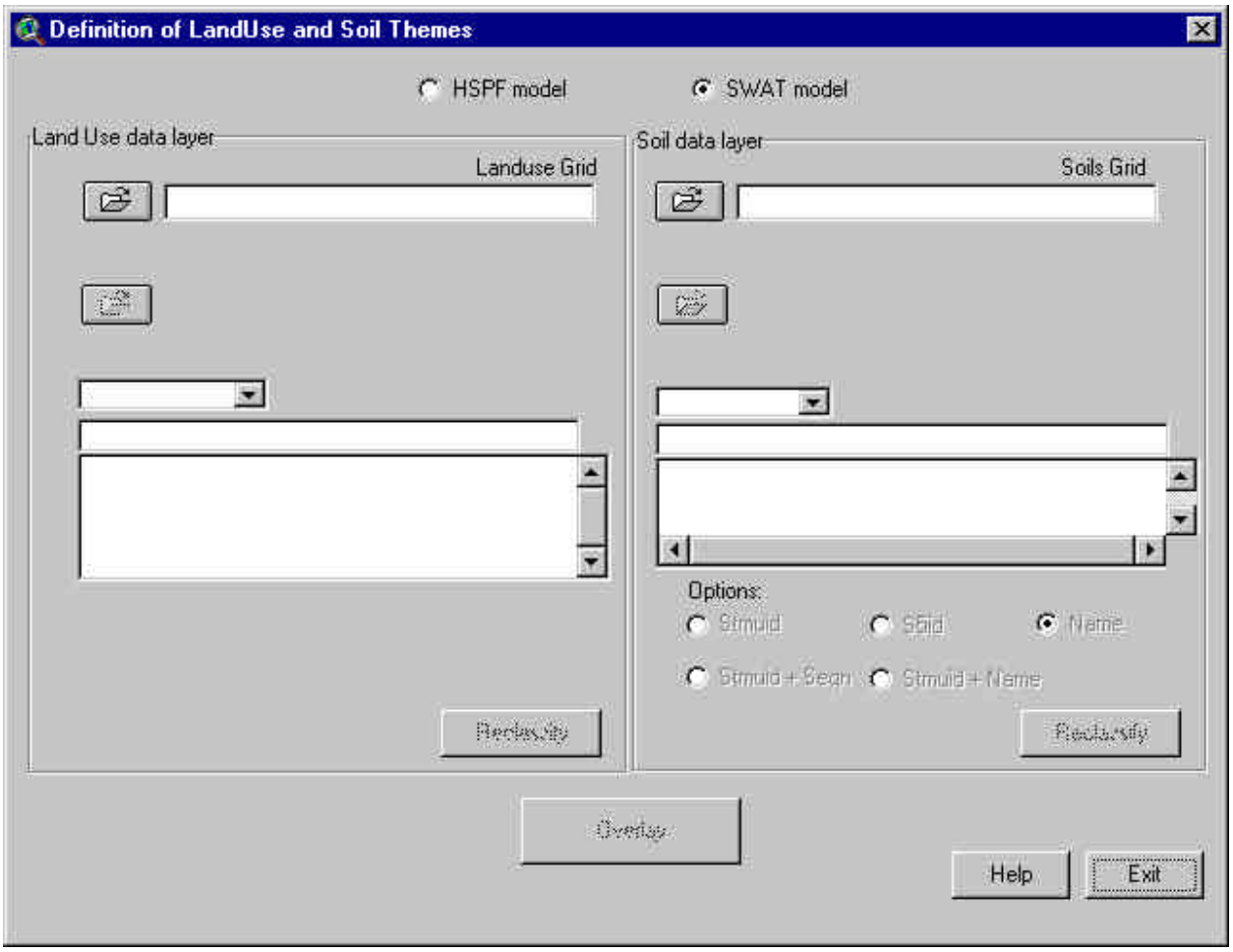
Before you Get Started First, verify that the *Landuse and Soil Classification and Overlay* extension is active in your BASINS project by typing Ctrl+B from the BASINS View (or selecting the BASINS *Extension* menu choice in the *File* menu) and selecting the *Watershed Utilities* item from the *Extension Categories* drop-down list. The *Landuse Soil Class and Overlay* entry in the *Basins Extensions* list should be visible and selected (Screen 9.1.1.1).

Screen 9.1.1.1

If the *Landuse Soil Class and Overlay* entry is not selected (checked), click on it to select it. Select *Land Use and Soil definition* (if enabled) from the *BASINS View* menu *Utilities* to start working with the tool (Screen 9.1.1.2).

Screen 9.1.1.2

The *Definition of Landuse and Soil themes* dialog will open (Screen 9.1.1.3).



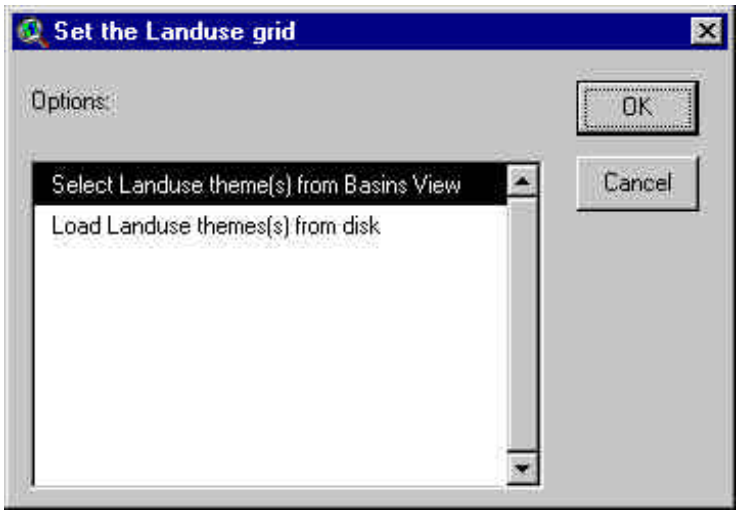
Screen 9.1.1.3

The dialog is divided into two main sections: *Land Use data layer* and *Soil data layer*

Land Use Data Layer Select the model to be used. You can select the SWAT or HSPF model by clicking the appropriate radio button. 

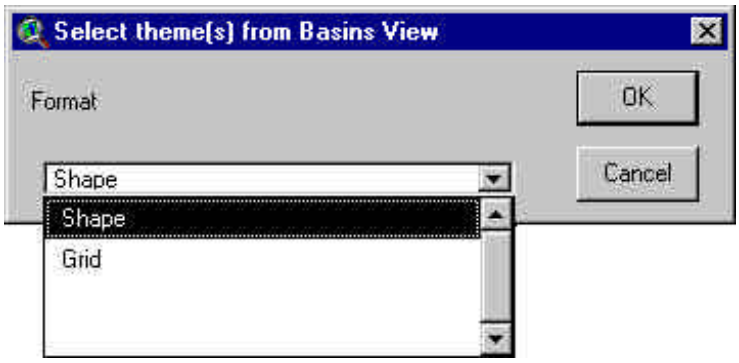
Define LandUse/LandCover theme:

 a. Select the land use data layer by clicking the button next to the text box labeled *Land Use Grid*. The *Set the LandUse Grid* dialog pops up (Screen 9.1.1.4).



Screen 9.1.1.4

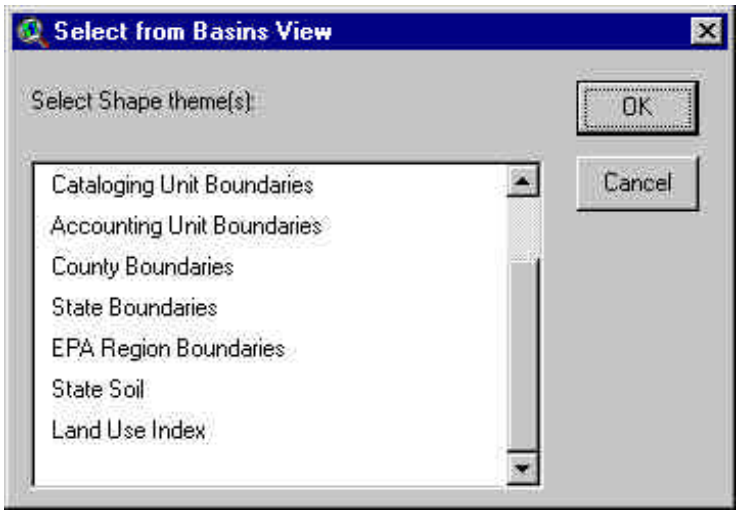
b. Load the land use theme(s) from the *BASINS View* or from the disk; then click OK (or double click the selection). A new dialog pops up Screen 9.1.1.5). Select either *Shape* or *Grid* from the drop-down menu and click **OK**.



Screen 9.1.1.5

c. If you selected the *Shape* option:

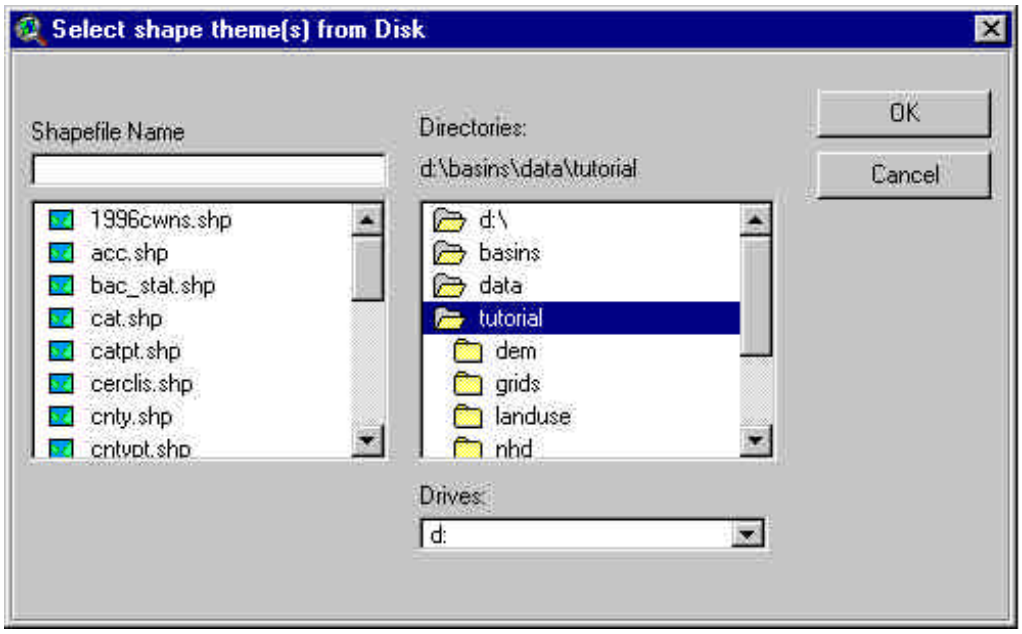
i. If loading from the *BASINS View*, a dialog pops up (Screen 9.1.1.6) showing the list of shape themes.



Screen 9.1.1.6

Select one or more themes (hold down the Shift key for a multiple selection) and click **OK**. The shape file(s) will be automatically converted to grid (and merged for a multiple selection).

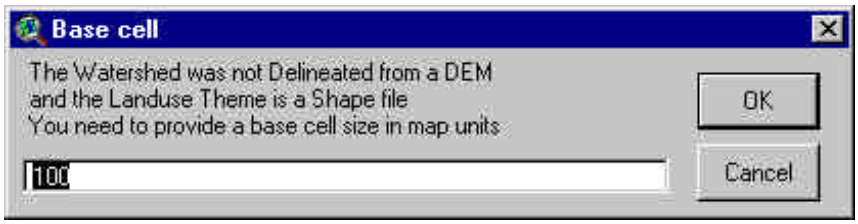
ii. If loading from disk, a file browser pops up (Screen 9.1.1.7).



Screen 9.1.1.7

Select one or more themes (hold the Shift key for a multiple selection) and click **OK**. A prompt box (Screen 9.1.1.8) pops up. Click **Yes** if the shape file(s) are already projected. Click **No** if not projected: the shape file(s) will be automatically projected before being converted to grid. Click **Cancel** if you want to stop the process.

If the watershed was not delineated using a DEM and the Automatic Delineation tool (see Sec. 8.2), a dialog box pops up (Screen 9.1.1.8), asking you to provide a base cell size in map units to convert the shape theme(s) to grid and clip them to the study watershed. Type the base cell value and click **OK**.

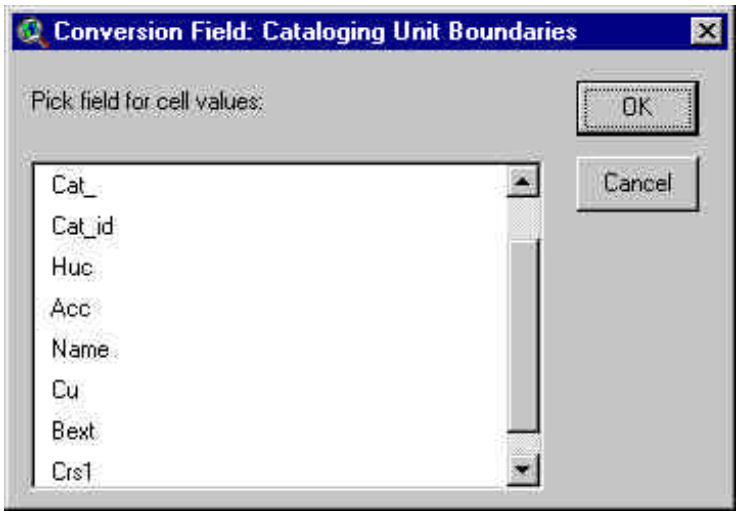


Screen 9.1.1.8

The selected themes are converted in a grid theme with cell size as the base cell size. By default the script will look for the *Lucode* field (contained in the USGS Landuse data distributed with BASINS) in the table of attributes of the shape themes and use these values for the conversion to grid. If this field is not included, the script will look for the field types integer and string . If none of these fields are found, a dialog box will report the lack of usable fields (Screen 9.1.1.9) and stop the process.

Screen 9.1.1.9

If more than one field is usable, a dialog box will list them (Screen 9.1.1.10), and you can select one and click **OK**.

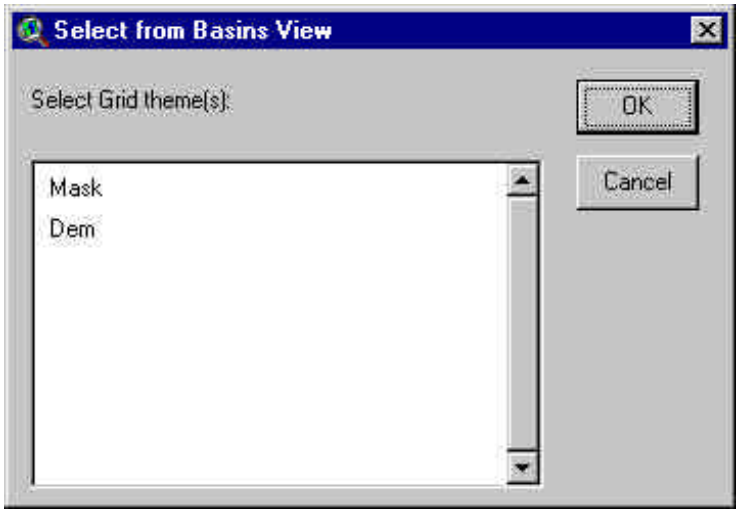


Screen 9.1.1.10

If more than one theme was selected, the interface will check if all of them contain the same selected field, and stop the process if the search returns an incorrect result.

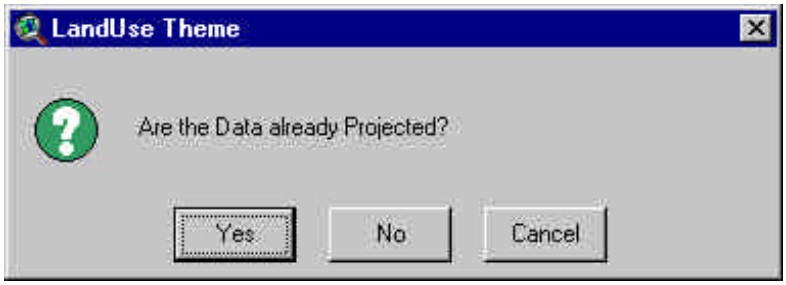
d. If you selected the *Grid* option:

i. If loading from the *BASINS View* a dialogs pops up (Screen 9.1.1.11) showing the list of grid themes.



Screen 9.1.1.11

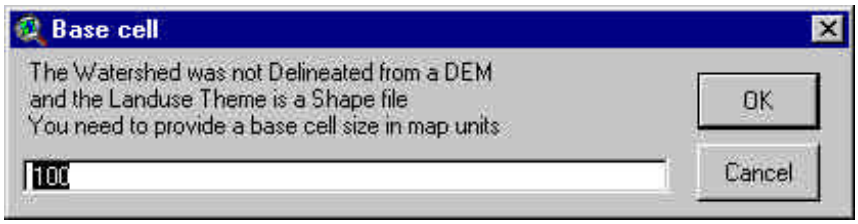
ii. If loading from disk a prompt dialog pops up (Screen 9.1.1.12).



Screen 9.1.1.12

Click **No** to exit, since the grid needs to be projected. Click **Yes** to proceed.

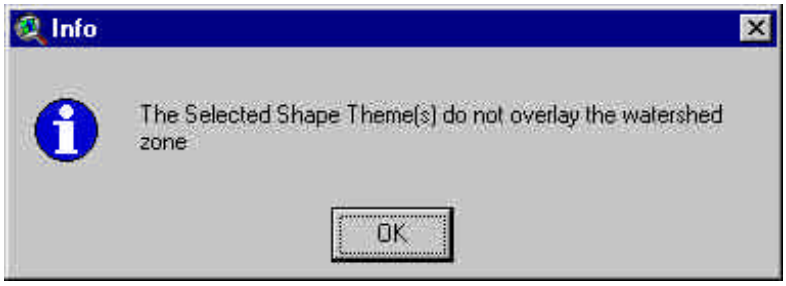
If the watershed was not delineated using a DEM and the Automatic Delineation tool (see Sec. 8.2), a dialog box pops up (Screen 9.1.1.13), asking you to provide a base cell size in map units. A base cell is requested for the next process of masking and clipping in the watershed area. The default base cell size is set as the cell size of the landuse grid. Type the base cell value and click **OK**.



Screen 9.1.1.13

Note: If the watershed was delineated using a DEM and the *Automatic Delineation tool* the base cell size is automatically set as the DEM grid cell.

The *Load and Clip Land Use* process might return an unsuccessful report (Screen 9.1.1.14) if none of the selected theme(s), either grids or shape, do not overlay part of the watershed. Click **OK** and the process will be stopped.



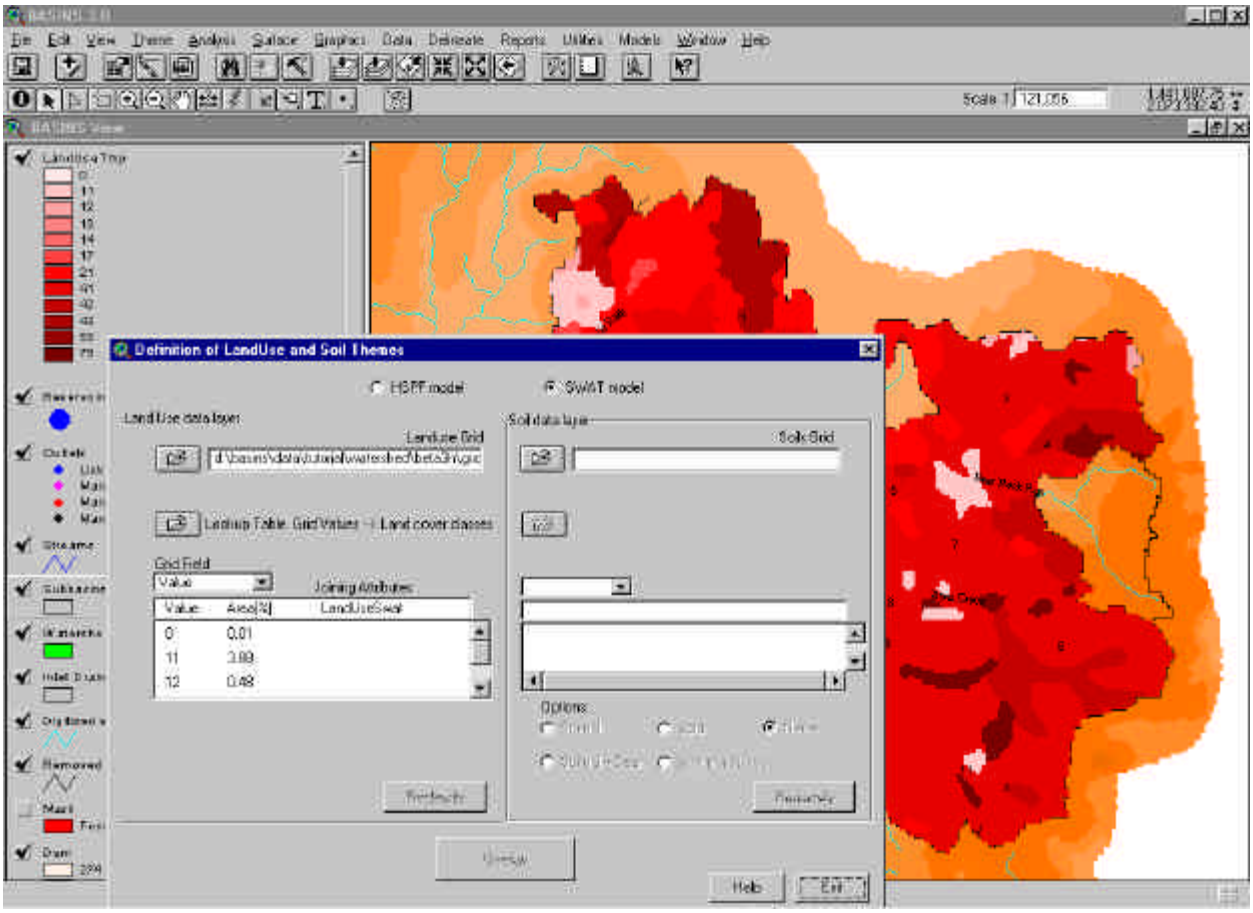
Screen 9.1.1.14

e. When this step is complete, a *Load and Clip Land Use* message box will appear informing you that the land use data have been clipped (and eventually resampled if the landuse grid cell size is different from the base cell size, and merged if more than one theme was selected) to the watershed and reminding you to load a look-up table or manually define the landuse classes (Screen 9.1.1.15).

Screen 9.1.1.15

The new *LanduseTmp* theme has been added to the *BASINS View*, and you can now check the results of the previous process. The path of the resulting grid is now shown in the the text box labeled *Landuse Grid*. A list box now shows the grid values and the respective percentage area in the watershed zone, as well as the *LanduseSwat* (or *LanduseHspf*) attribute that will store the land cover/plant description

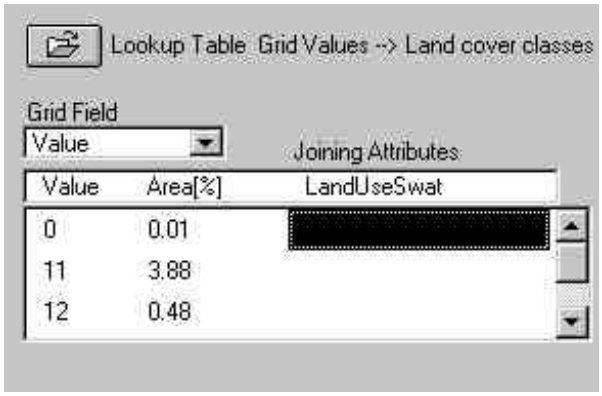
(Screen 9.1.1.16).



Screen 9.1.1.16

Click **OK** to proceed. This will return you to the *Definition of LandUse and Soil Themes* dialog box.

Using the *Landuse Reclass Section* (Screen 9.1.1.17)

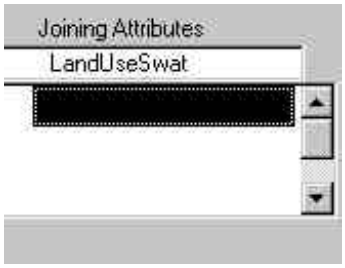


Screen 9.1.1.17

Select the Grid attribute field containing the codes to be reclassified.
The land use grid codes must be assigned to a land cover/plant description.

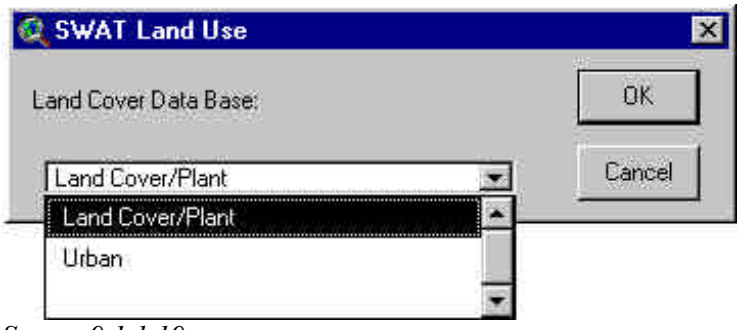
You can manually assign a land cover/plant code or use a look-up table.

a. To manually assign land cover/plant codes, double-click in the *LandUseSwat* (*LandUseHspf*) spot in the *Joining Attributes* box (Screen 9.1.1.18).



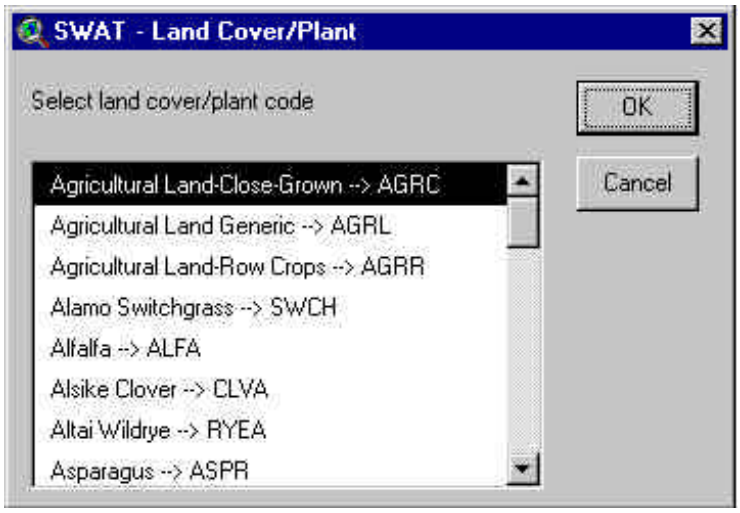
Screen 9.1.1.18

i. With the SWAT option a dialog pops up listing two database files from which a SWAT land type can be selected: Land Cover/Plant or Urban (Screen 9.1.1.19).

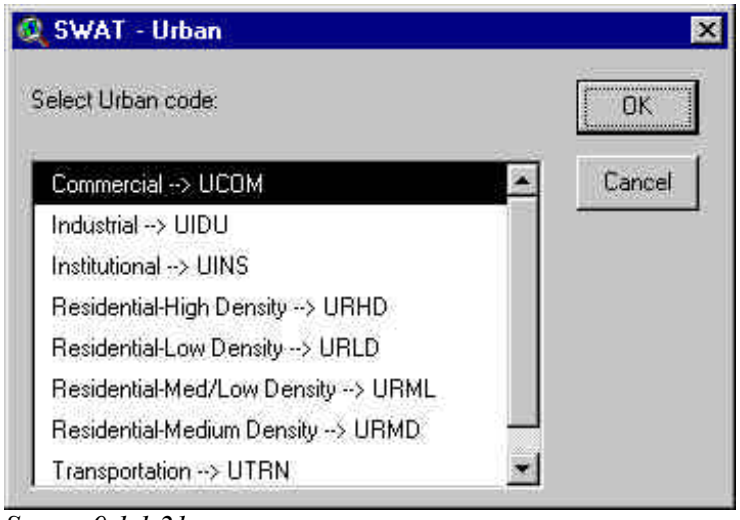


Screen 9.1.1.19

Select the desired database file by clicking on it and click OK (or Cancel to exit). A dialog box will pop up listing the available SWAT land cover codes (Screen 9.1.1.20) or the available SWAT urban land type codes (Screen 9.1.1.21).



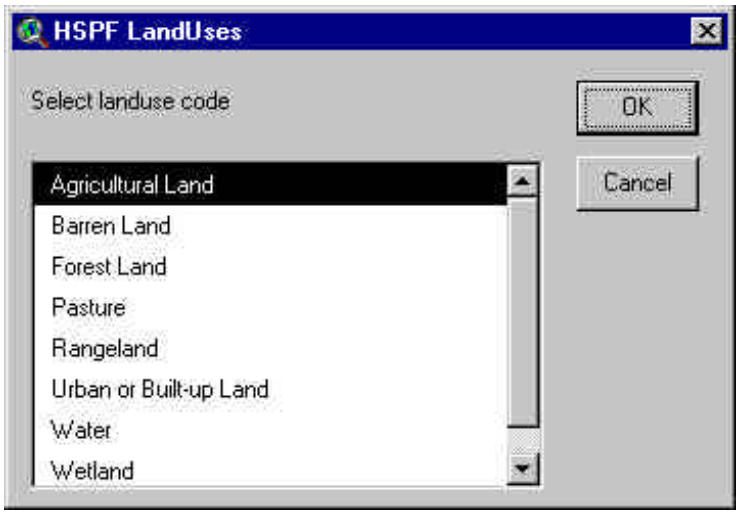
Screen 9.1.1.20



Screen 9.1.1.21

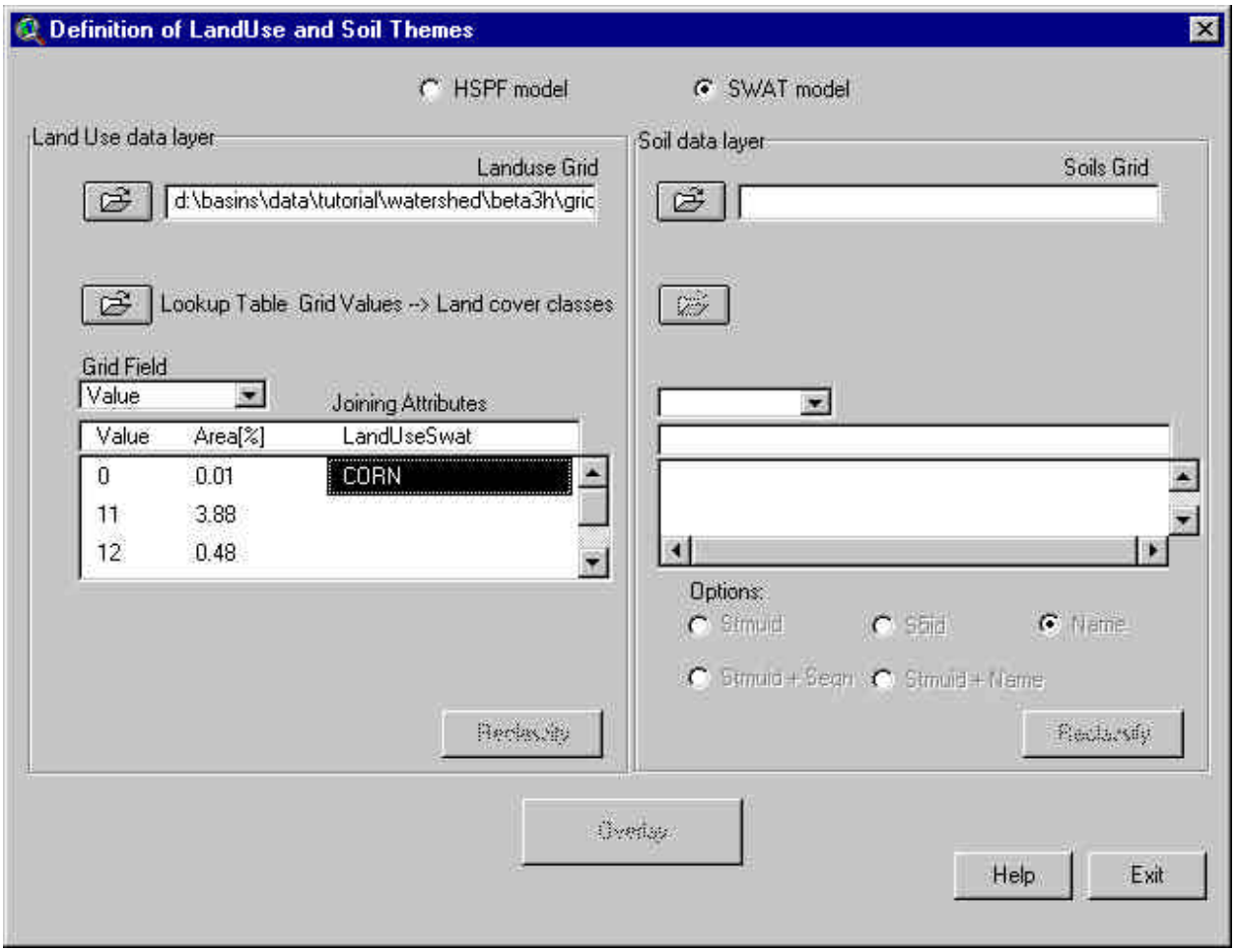
Tip: Edit in advance the SWAT Land use/Plant Growth data base (see 12.1, SWAT model extension) to include a new target class for the reclassification.

ii. With the HSPF option a dialog pops up (Screen 9.1.1.22) listing the HSPF land type codes.



Screen 9.1.1.22

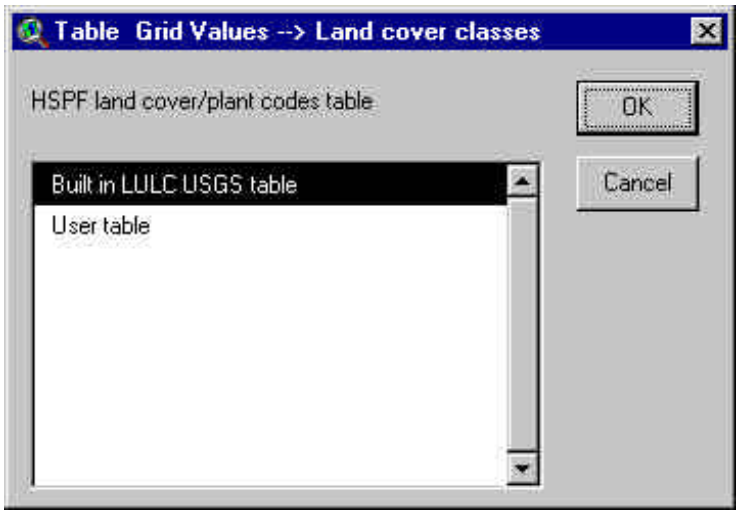
Scroll down the list, select the target code by clicking on it and click **OK** (or double click the selection). The SWAT (or HSPF) land cover or urban code will be displayed next to the corresponding land use map category in the *Definition of Land Use and Soil Themes* dialog box (Screen 9.1.1.23).



Screen 9.1.1.23

b. To load and join a look-up table select the land use look-up table by clicking on the open button in the Look up table section

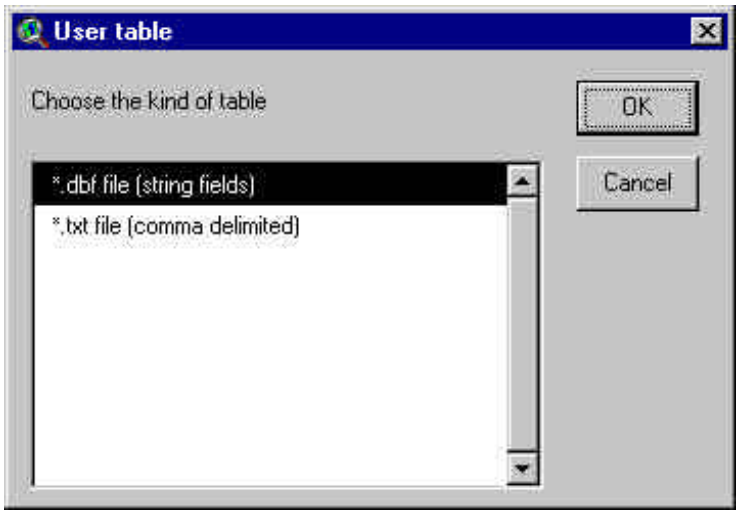
A dialog box pops up (Screen 9.1.1.24).



Screen 9.1.1.24

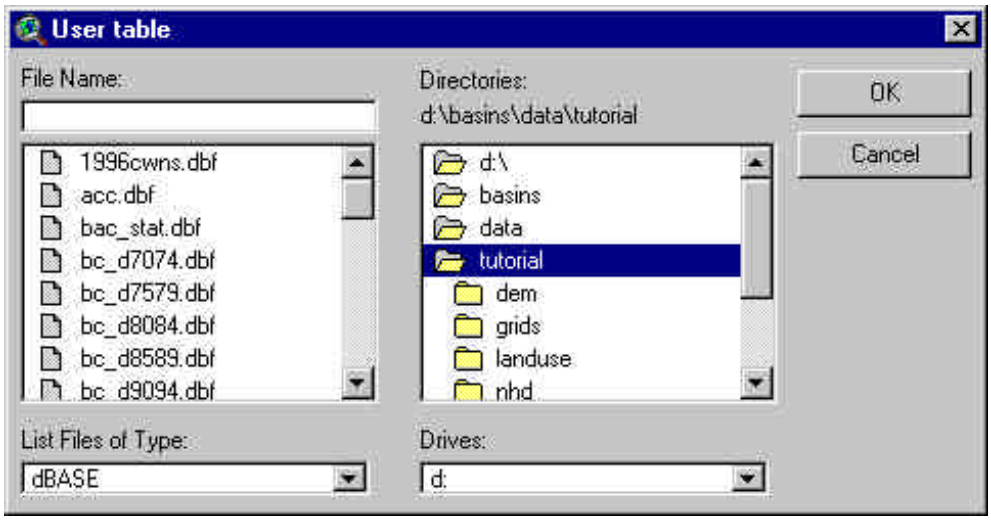
i. Select the Built-in *LULC USGS table* option to apply a built-in table that converts the USGS land use/land cover classification codes to SWAT (or HSPF) land cover/plant codes.

ii. Select the *User table* option to use a different classification set. Click **OK**. A dialog allows you to select one of the two available formats (Screen 9.1.1.25),



Screen 9.1.1.25

dBASE and ASCII, and the table from disk. The Table *Grid Values > Landuse Attributes* dialog box will appear, allowing you to select and load the look-up table from disk (Screen 9.1.1.26).

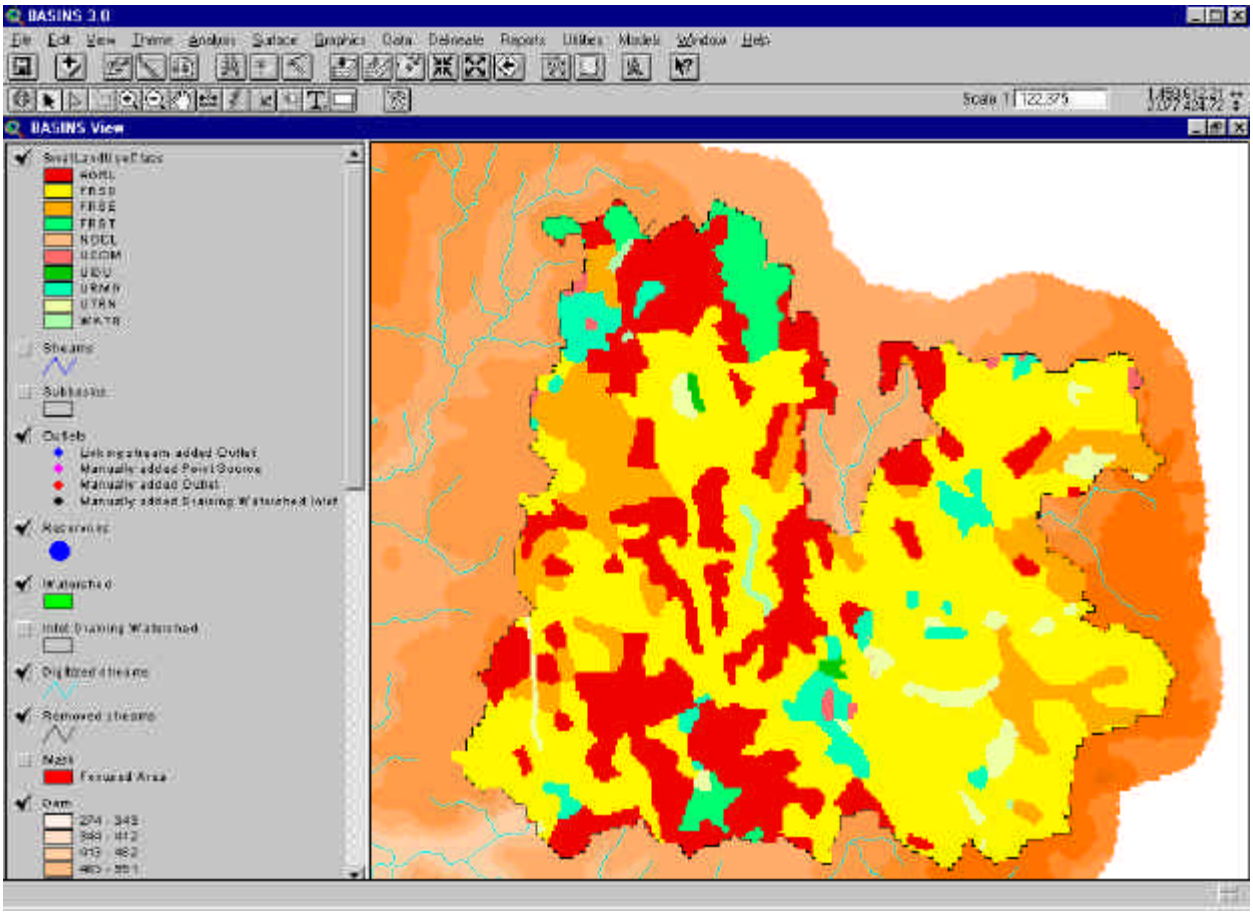


Screen 9.1.1.26

Note: for the look up table format (dBASE and ASCII) see *the Land Use Lookup Table*.

Repeat these steps until all the LanduseSWAT or (LanduseHSPF) records are set. The *Reclassify* button will be enabled. Click the Reclassify button.

A new theme named SwatLanduseClass (or HspfLanduseClass) will be set within the *Basins View* (Screen 9.1.1.27).



Screen 9.1.1.27

The map grid has been reclassified and eventually resampled at the grid resolution specified by the base cell size.

TUTORIAL:

Select the SWAT option (button).

Load the LandUse shape files from disk /basins/data/tutorial/landuse.

Load the "Built-in LULC USGS look up table. (If there is, replace the "NOCL" landuse class).

Click the **Reclassify** button

Soil data layer  Define the *Soil* theme clicking the button next to the text box labeled *Soil Grid*.

You can follow the same steps described above for selecting the land use layer. Some differences are:

a. If the selected theme(s) are type shape by default the interface will look for one of the follow fields (with the ordered priority) *Muid,Stmuid,Name,S5id, and Seqn* for the convertion to grid.

Note: Statsgo *State soil* data theme distributed with BASINS, usually is the *BASINS View*, contains the *Muid* field in the table of attributes.

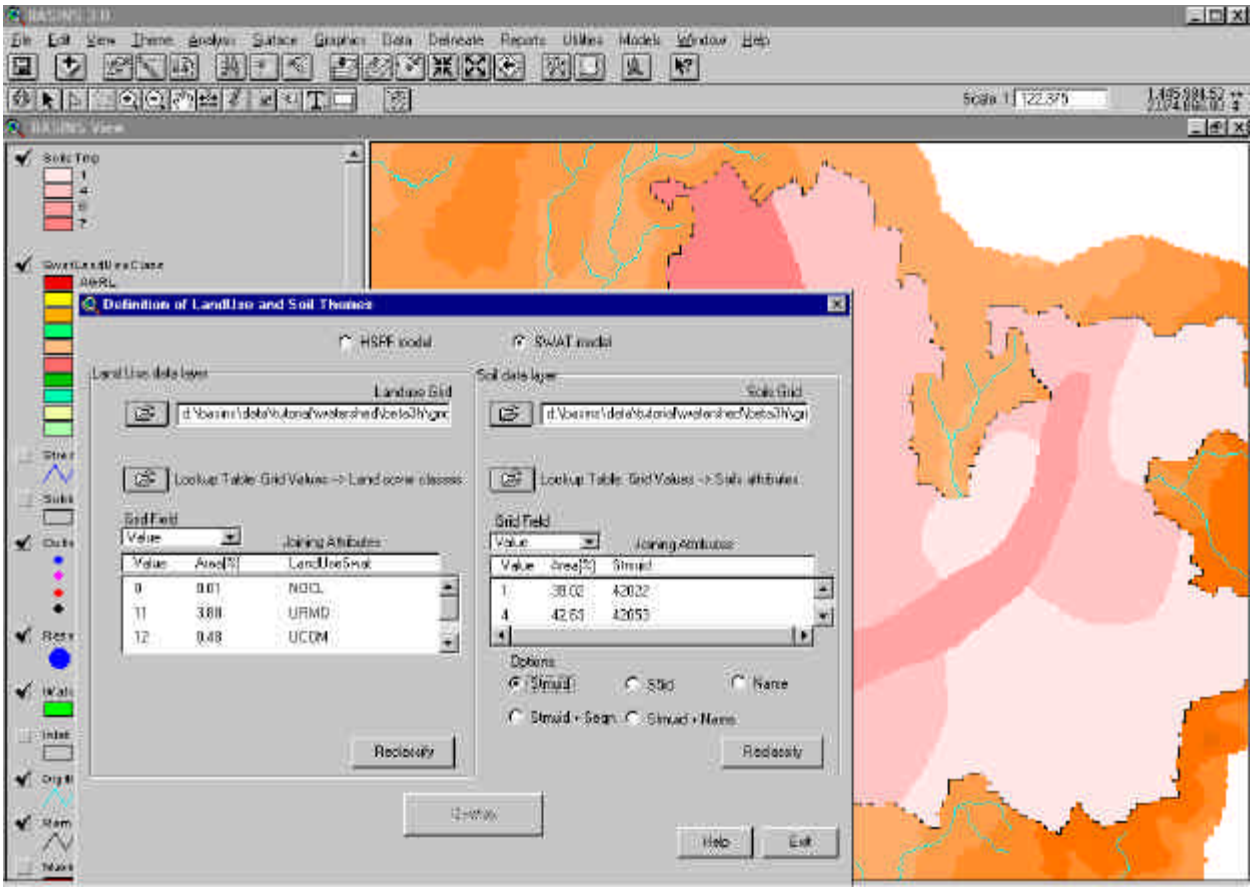
If none of these fields is included see the land use layer description.

b. If the selected theme(s) (either grid or shape) table of attributes contains the following field values: *Muid (or Stmuid), Seqnum(or Seq),S5id, Name (or Compname)*, the values will be carried to the resulting grid to be reclassified.

When the loading, conversion, and clipping are complete, a message box pops up informing you that the soil data have been clipped to the watershed and reminding you to load a look-up table (Screen 9.1.1.28).

Screen 9.1.1.28

Click **OK** to proceed. The new SoilTmp theme has been added to the BASINS View. The path of the resulting grid is now shown in the *Soils Grid* text box. A list box now shows the grid values and the respective percentage area in the watershed zone as well as the attributes that will store (some could be already populated) the soil description (Screen 9.1.1.29).



Screen 9.1.1.29

The soil map grid value can be assigned, manually or using a look up table, to a string Name for user provided soil data (with the SWAT option the soil with the same name must be set in the User Soils database) or to the U.S. STATSGO soils database (included in BASINS database). These options are driven by the soils options radio buttons (Screen 9.1.1.30).

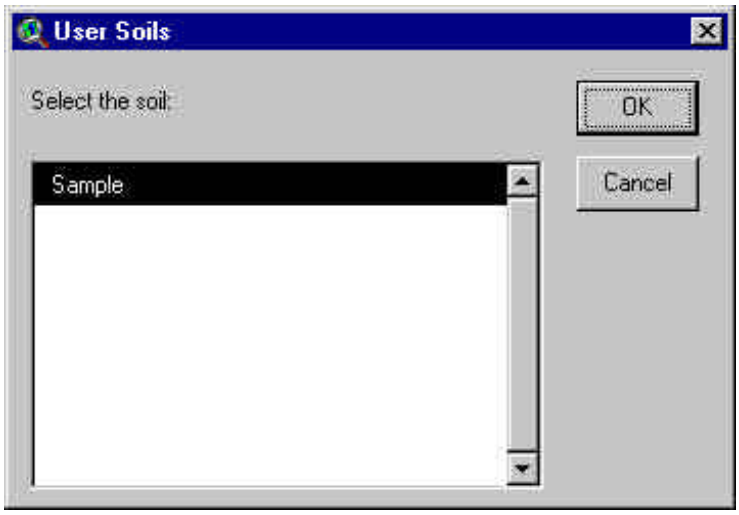
Screen 9.1.1.30

a. To manually assign soil codes, double click in the empty records below the *Joining Attributes* label.

i. For user provided soil data click the radio button labeled *Name*.

Only the records labeled *Name* are available. Double click a record.

SWAT. The dialog shown in the Screen 9.1.1.31 pops up.



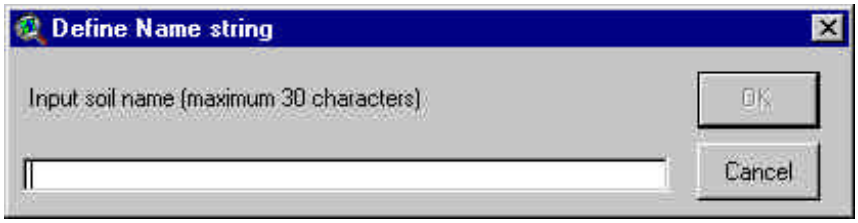
Screen 9.1.1.31

The soils entry in the *SWAT User Soils* data base are listed.

Tip: Input your soils entry and data sets in the User Soils data base (See Section 12.1) before you reclassify the Soil grid.

Select the entry and click OK (or double click the selection).

HSPF. The dialog shown in the Screen 9.1.1.32 pops up.



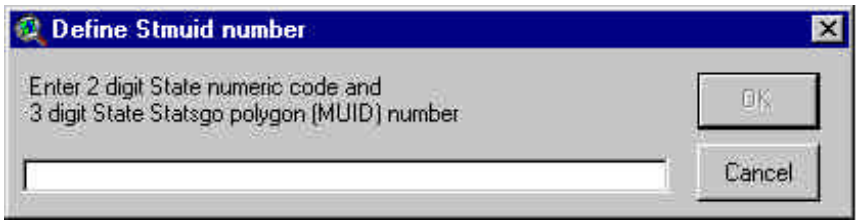
Screen 9.1.1.32

The soils entry can be typed in the text box. Click **OK**. The entry is now set in the selected record.

ii. For the use of STATSGO data base the user has four options:

Stmuid. Allows you to specify the State STATSGO polygon number and the dominant soil phase. Click the Stmuid radio button.

Double clicking the respective record brings up an entry dialog (Screen 9.1.1.33).



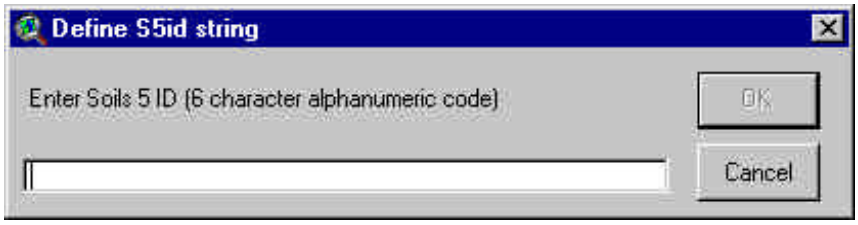
Screen 9.1.1.33

The Stmuid entry can be typed in the text box. Click **OK**. The entry is now set in the selected record.

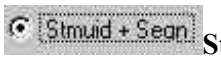
S5id. Allows you to specify the Soils5ID number for USDA soil series data. Click the *S5id* radio button.

Double clicking the respective record brings up an entry dialogue.

The *S5id* entry can be typed in the text box. Click **OK**. The entry is now set in the selected record.

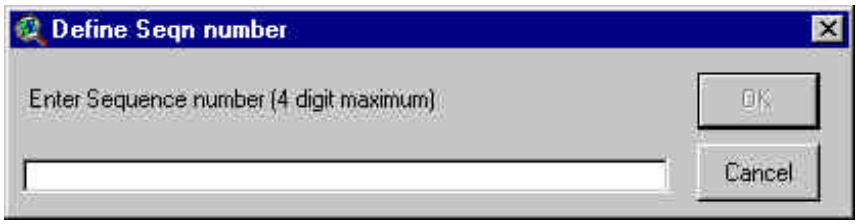


Screen 9.1.1.34



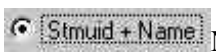
Stmuid+Seqn. Allows you to specify the State STATSGO polygon number and sequence number of soil phase. Click the Stmuid + Seqn radio button.

See *Stmuid* option to set the Stmuid entry. Double clicking the *Seqn* record brings up an entry dialog.



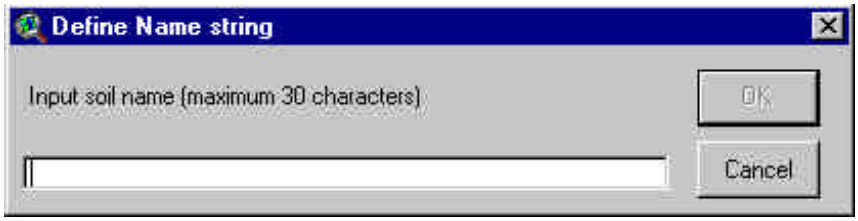
Screen 9.1.1.35

The Seqn entry can be typed in the text box. Click **OK**. The entry is now set in the selected record.



Name + Stmuid. Allows you to specify the State STATSGO polygon number and soil series name. Click the Name + Stmuid radio button.

Double clicking the *Name* record brings up an entry dialog.

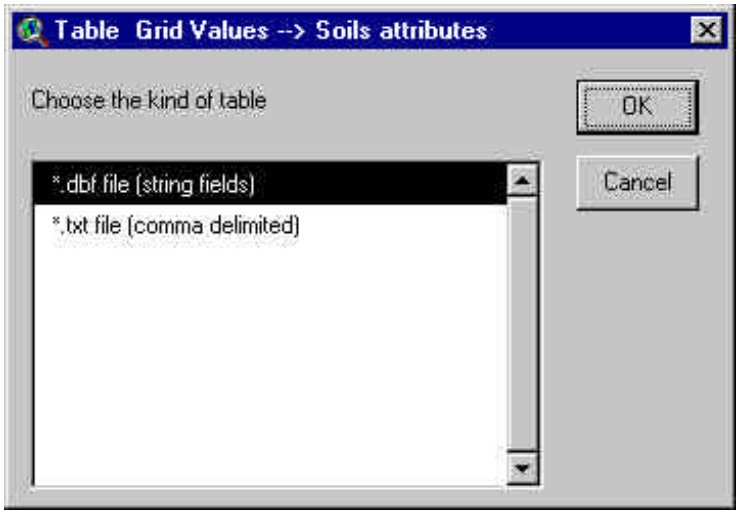


Screen 9.1.1.36

The Name entry can be typed in the text box. Click **OK**. The entry is now set in the selected record. See *Stmuid* option to set the Stmuid entry.

b. To load and join a look-up table, select the land use look-up table by clicking on the open button in the Look up table section.

A dialog box pops up (Screen 9.1.1.37).

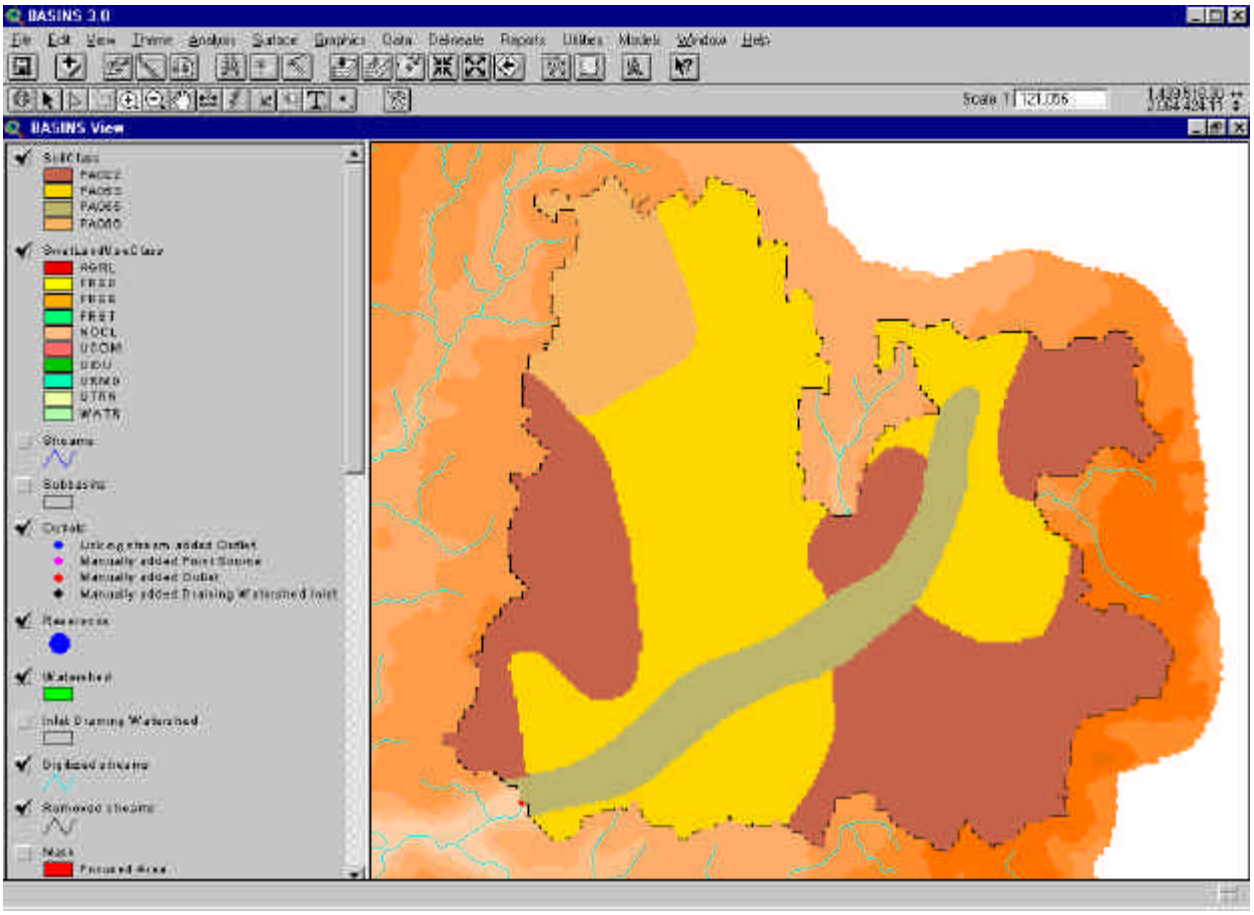


Screen 9.1.1.37

Note: for the look up table format (dBASE and ASCII) see *Soil Lookup Table*.

Repeat these steps until all the option related records are set. The **Reclassify** button will be enabled. Click the **Reclassify** button.

A new theme named *SoilClass* will be set within the *Basins View* (Screen 9.1.1.38).



Screen 9.1.1.38

The soil map grid has been reclassified and resampled at the grid resolution specified by the base cell size.

TUTORIAL:

Select the “State Soil” theme from BASINS View.

Select the “Stmuid” button

Click the “Reclassify” button

When both the landuse and soil grids are reclassified the *Overlay* button is enabled. Click the **Overlay** button to start the overlay process.

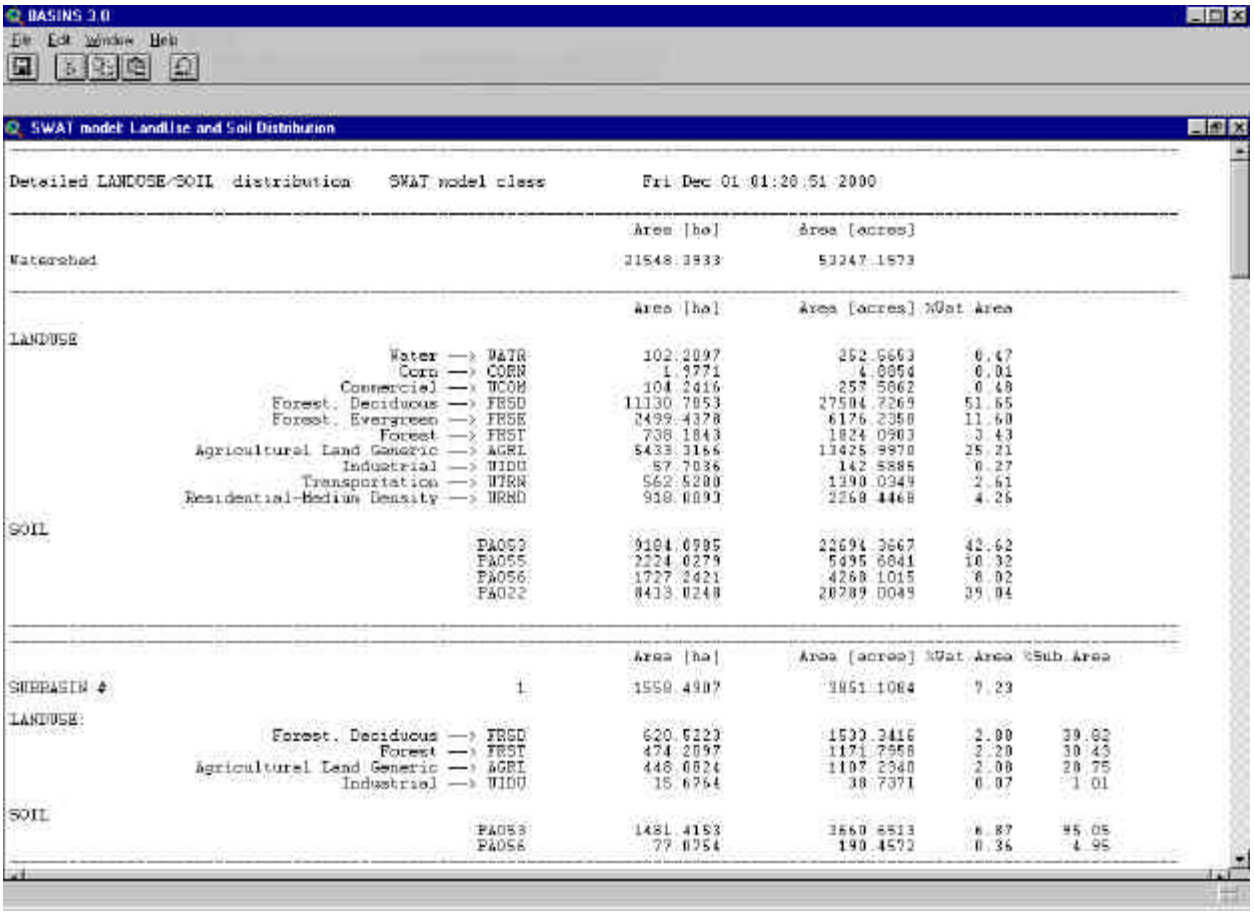
Note: with the SWAT option if one entry of the *LandUseSwat* is *NOCL*, you need to replace this class and reclassify the grid, as a message box will indicate (Screen 9.1.1.39).

Screen 9.1.1.39

A message box signals the end of the overlay process (Screen 9.1.1.40).

Screen 9.1.1.40

A new report named *SWAT model: LandUse and Soil Distribution* (or *Hspf model: ....*) is now available (Screen 9.1.1.41). This report provides a detailed description of the distribution of the landuse and soil classes in the watershed and all the sub-watersheds.



Screen 9.1.1.41

You can go to the determination of hydrologic response units (HRUs) (Section 10.3).

Land use look up table

The land use look-up table used to specify the SWAT (or HSPF) land use classes, can be dBASE or ASCII format with the following structure: dBASE: the table must contain 2 fields as described here.

Field name*	Field Type	Definition
VALUE	string	Number of map category
LANDUSE	string 4 chars for SWAT string max 30 chars for HSPF	Corresponding SWAT land cover/plant growth or urban code or HSPF land use class name

*These specific field names must be used in to properly access the information.

ASCII (.txt): comma delimited text table as in the following example: `"Value","Landuse"`
`1,RNGE`

```
2,PAST
3,FRSD
4,WATR
5,AGRL
6,URBN
```

Soil look up table

The soil look-up table used to specify the soil classes will vary depending on the option chosen to link the soil data to the soil map. The table can be dBASE or ASCII format with the following structure: dBASE: the table must contain the fields as described here.

Look up table format: Stmuid option (2 fields)

Field name	Field format	Definition
VALUE	string	Number of map category
STMUID	string 5 chars	5-digit number: digits 1-2: numeric code for state; digits 3-5: STATSGO polygon number

Look up table format: S5id option (2 fields)

Field name	Field format	Definition
VALUE	string	Number of map category
S5ID	string 6 chars	6-character alphanumeric code for SOILS-5 data for the soil series

Field name	Field format	Definition
VALUE	string	Number of map category
NAME	string (30 chars max)	Name of the soil. For SWAT this is the name of one of the soils entered in the *User Soil* database (see Sec.12.1)

Look up table format: Stmuid + Seqn option (3 fields)

Field name	Field format	Definition
VALUE	string	Number of map category

STMUID	string 5 chars	5-digit number: digits 1-2: numeric code for state; digits 3-5: STATSGO polygon number
SEQN	string	Sequence number of soil within the STATSGO polygon. (2nd most dominant soil, SEQN=2; 3rd most dominant soil, SEQN=3, etc.)

Look up table format: Stmuid + Name option (3 fields)

Field name	Field format	Definition
VALUE	string	Number of map category
STMUID	string 5 chars	5-digit number: digits 1-2: numeric code for state; digits 3-5: STATSGO polygon number
NAME	string (30 chars max)	Name of soil within the STATSGO polygon

ASCII (.txt): comma delimited text table as in the following example: `"Value","Stmuid"`

```
1,48047
2,48236
3,48357
4,48619
5,48620
6,48633
```

9.1.2 HRUs Distribution

Purpose

Before the set up of the *SWAT* model, the distribution of hydrologic response units (HRUs) within the watershed must be determined based on the land use and soil data layers specified in the previous step (see section 9.1.1). The *HRUs Distribution* choice in the *Utilities* menu allows the user to specify criteria to be used in determining the HRU distribution. One or more unique land use/soil combinations (hydrologic response units or HRUs) can be created for each subbasin. Although not directly used by *HSPF*, the HRUs can be used to assess the varying hydrologic conditions between sub-watersheds.

Application

Subdividing the watershed into areas having unique land use and soil combinations enables the model to reflect differences in evapotranspiration and other hydrologic conditions for various crops and soils. With *SWAT* model, runoff is predicted separately for each HRU and routed to obtain the total runoff for the watershed. This increases accuracy and gives a much better physical description of the water balance.

The user has two options in determining the HRU distribution: assign a single HRU to each subwatershed or assign multiple HRUs to each subwatershed. If a single HRU per subbasin is selected, the HRU is

determined by the dominant land use category and soil type within each watershed. If multiple HRUs are selected, the user may specify sensitivities for the land use and soil data that will be used to determine the number and kind of HRUs in each watershed.

Key Procedures

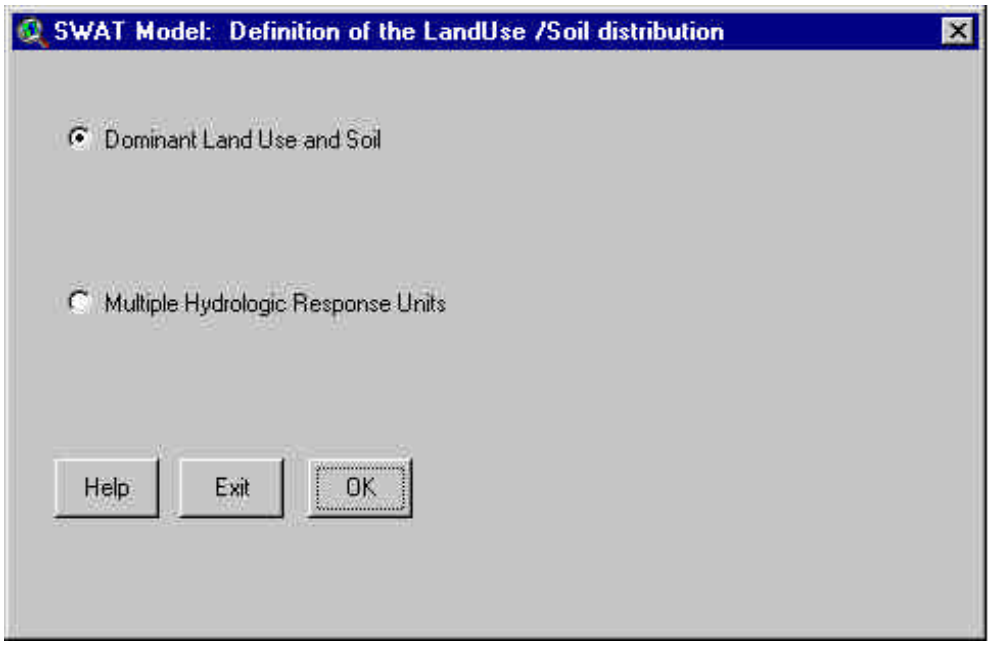
- Select single or multiple HRUs per subwatershed
- For multiple HRUs, define land use and soil threshold levels
- Click the **OK** button to determine the HRU distribution
- Click the **Exit** button when the distribution is satisfactory

Detailed Operations

The *HRUs Distribution* Extension is loaded with the *Landuse and Soil Classification and Overlay* Extension. See Section 9.1.1 for instructions about how to load these extensions. Select the item *HRU distribution*, if enabled, from the *BASINS View* menu *Utilities* to start working with the tool (Screen 9.1.2.1).

Screen 9.1.2.1

The dialog named *Swat Model: definition of the land use / soil distribution* (or *HSPF model:...*) will open (Screen 9.1.2.2).

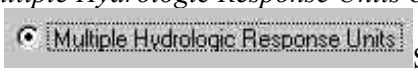


Screen 9.1.2.2

Two radio buttons allow you to choose between two options: *Dominant Land Use and Soil* or *Multiple Hydrologic Response Units*.

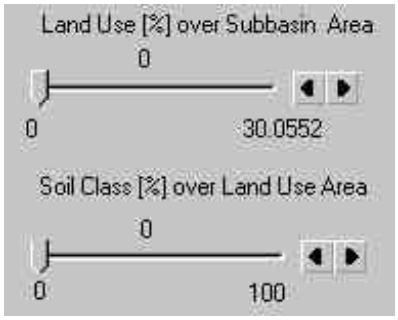
a. The *Dominant Land Use and Soil* option will you allow to create only one HRU for each subbasin defining the dominant landuse and soil class.

Select the respective radio button.

b. The *Multiple Hydrologic Response Units* option will allow you to create multiple HRUs within each subbasin. 

Select the respective radio button.

Two slide bars are now visible (Screen 9.1.2.3).



Screen 9.1.2.3

Note: The creation of multiple HRUs is a two-step process. First, land uses are chosen. Once the land uses to be modeled are determined, the different soils for each land use are chosen. One HRU is created for each unique land use/soil combination.

The first scale controls the threshold level used to eliminate minor land uses in each subbasin. Land uses that cover a percentage of the subbasin area less than the threshold level are eliminated. After the elimination process, the area of the remaining land uses is reapportioned so that 100% of the land area in the subbasin is modeled.

For example, assume there is a subbasin that contains

- 35% agricultural land in corn
- 30% pasture
- 21% forest
- 10% agricultural land in orchard
- 4% urban

If the threshold level for land use is set to 20%, HRUs would be created for pasture, forest, and corn and the areas of the modeled land uses would modified as follows:

- corn: (35% ÷ 86%) x 100% = 41%
- pasture: (30% ÷ 86%) x 100% = 35%
- forest: (21% ÷ 86%) x 100% = 24%

where 86% was the percentage of the subbasin originally covered by pasture, forest, and corn.

The second scale controls the creation of additional HRUs based on the distribution of the selected land uses over different soil types. This scale is used to eliminate minor soils within a land use area. As with the land use areas, once minor soil types are eliminated, the area of the remaining soils is reapportioned so that 100% of the land use area is modeled.

For example, assume that the overlay performed by the interface during the processing of the land use and soil maps identified the following soil distribution for pastureland in the subbasin:

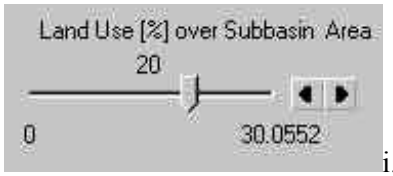
- 20% Houston Black
- 25% Branyon
- 15% Heiden
- 10% Austin
- 7% Stephen
- 6% Denton
- 5% Frio
- 4% Purves
- 3% Bastrop
- 2% Altoga
- 1% Eddy
- 1% San Saba
- 1% Ferris

If the threshold level for soils within a land use area is set to 10%, the following HRUs will be created for this example:

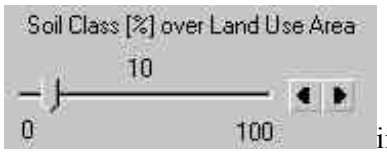
- pasture/Houston Black
- pasture/Branyon
- pasture/Heiden
- pasture/Austin

This process is performed for every land use to be modeled in the subbasin.

The threshold levels set for multiple HRUs is a function of the project goal and the amount of detail desired by the modeler. For most applications, the default settings for land use threshold (20%) and soil threshold (10%) are adequate.



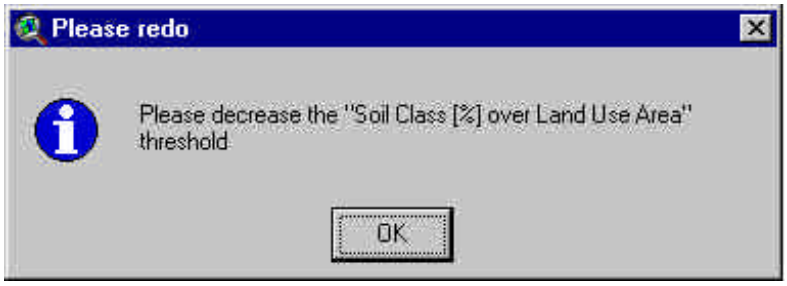
i. Specify the *Landuse* threshold level by moving the pointer on the first slide bar.



ii. Specify the *Soil* threshold level by moving the pointer on the second slide bar.

Click **OK**.

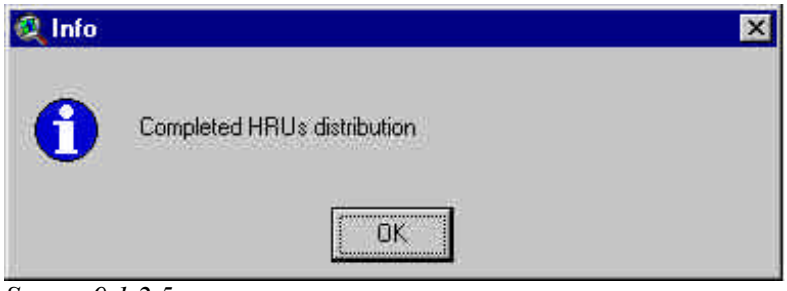
If thresholds have been set you may see a message dialog (Screen 9.1.2.4).



Screen 9.1.2.4

In this case decrease the Soil threshold value and try again.

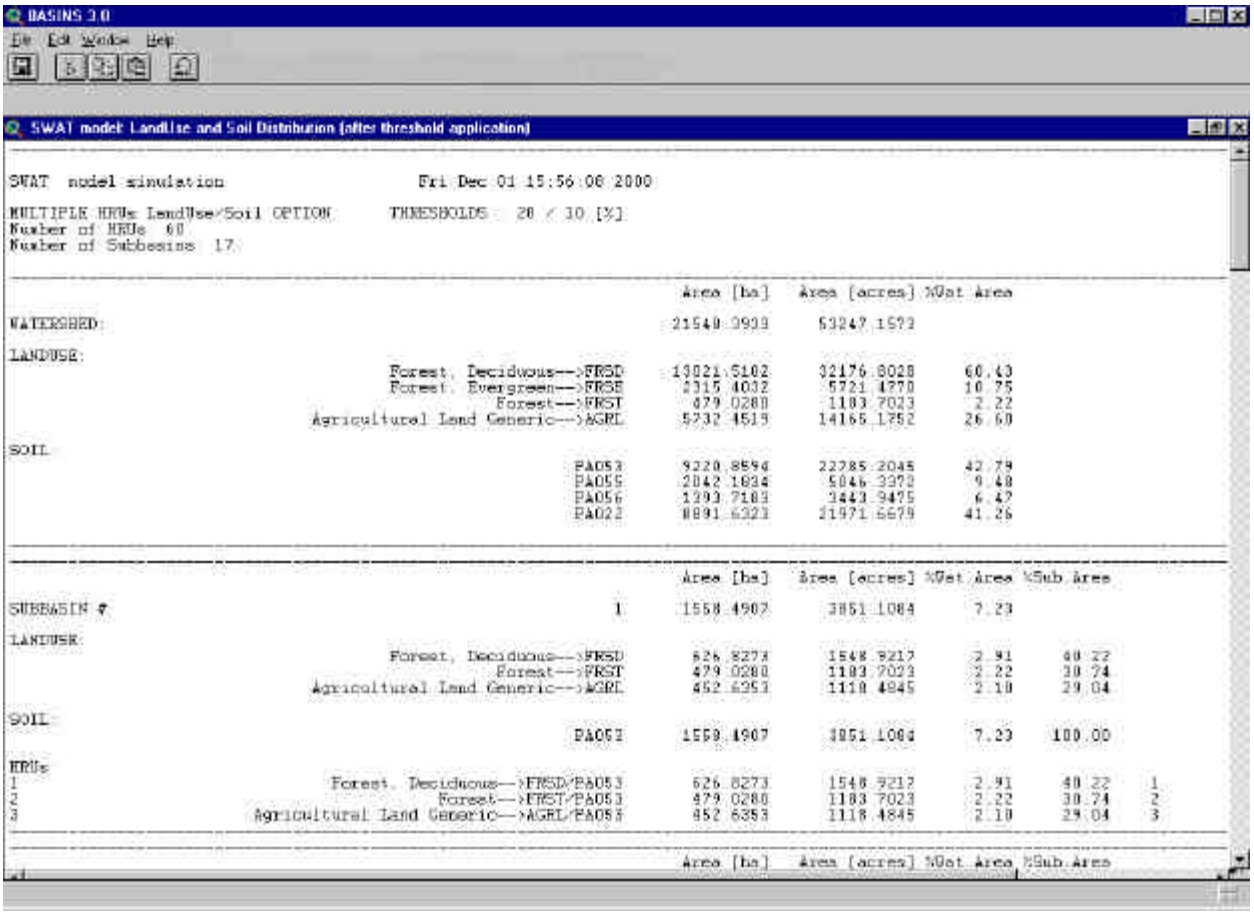
Once the HRUs are created a message dialog pops up (Screen 9.1.25)



Screen 9.1.2.5

A new report and a new table have been added to the project.

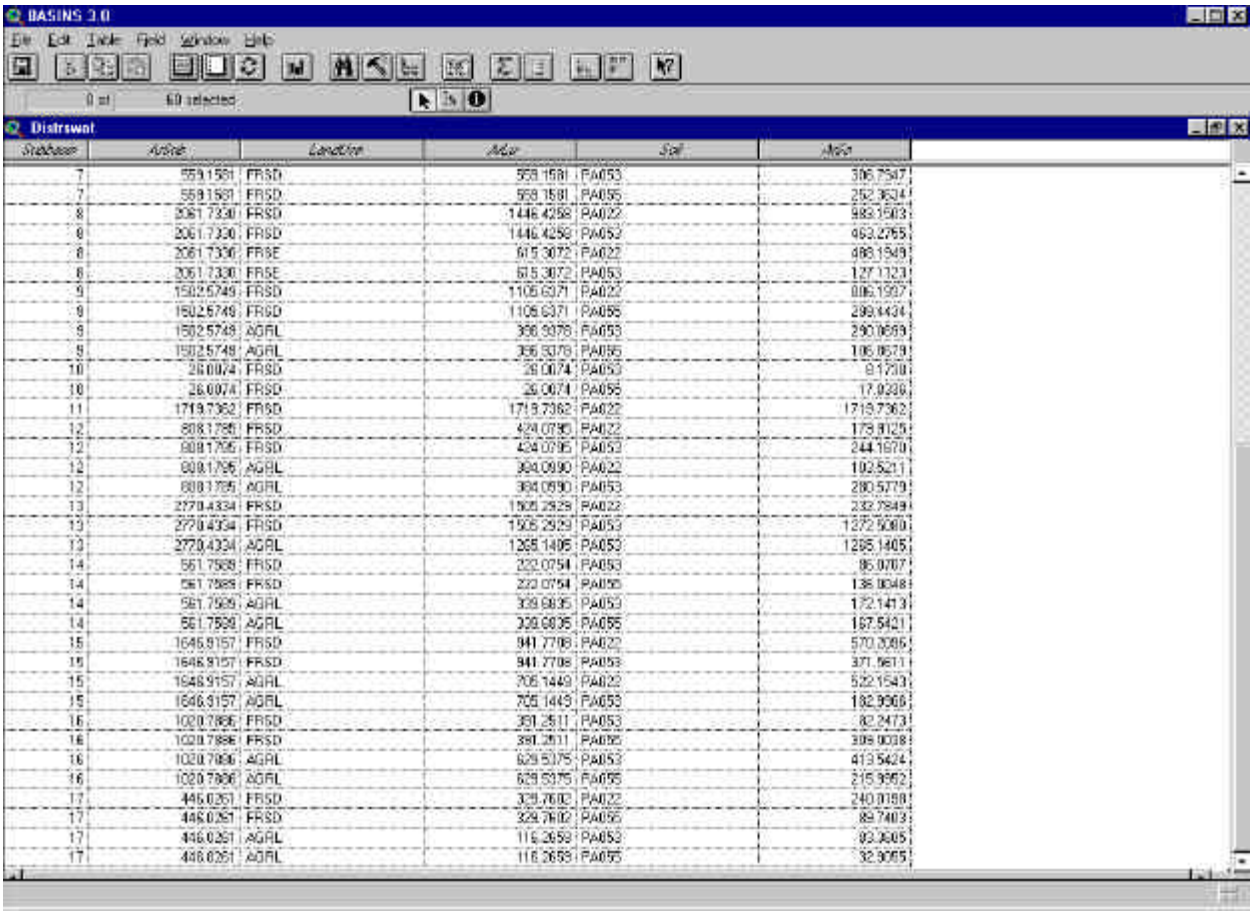
i. The new report is named *SWAT model: LandUse and Soil Distribution* (after threshold application) (or *Hspf model: ....*) (Screen 9.1.2.6).



Screen 9.1.2.6

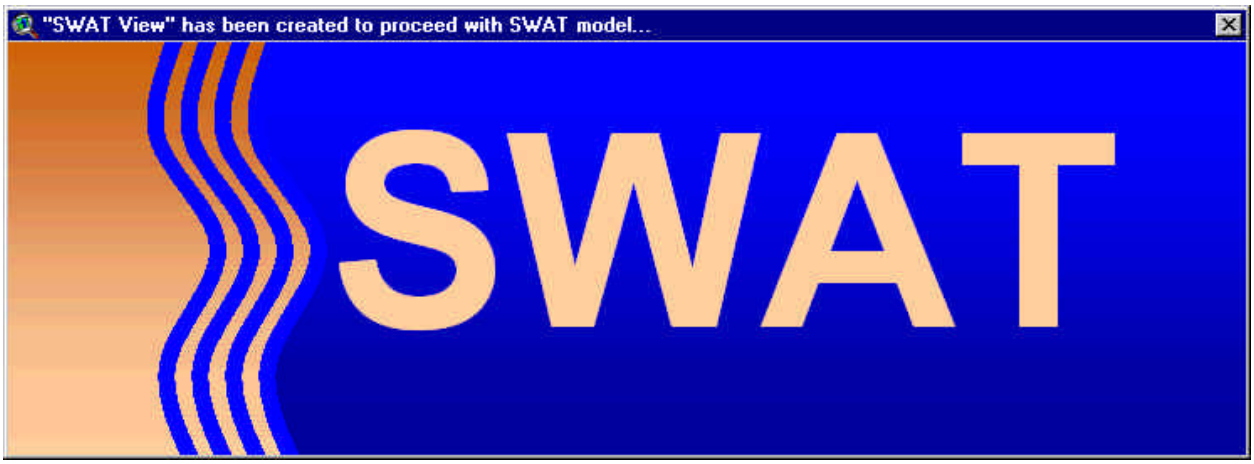
This report provides a detailed description of the distribution of the HRUs, landuse and soil classes in the watershed and all the sub-watersheds.

ii. The added table is named *Distrswat* (or *DistrHspf*). This table provides the areal distribution (in hectares) of the HRUs, landuse and soil classes in all the sub-watersheds (Screen 9.1.2.7)



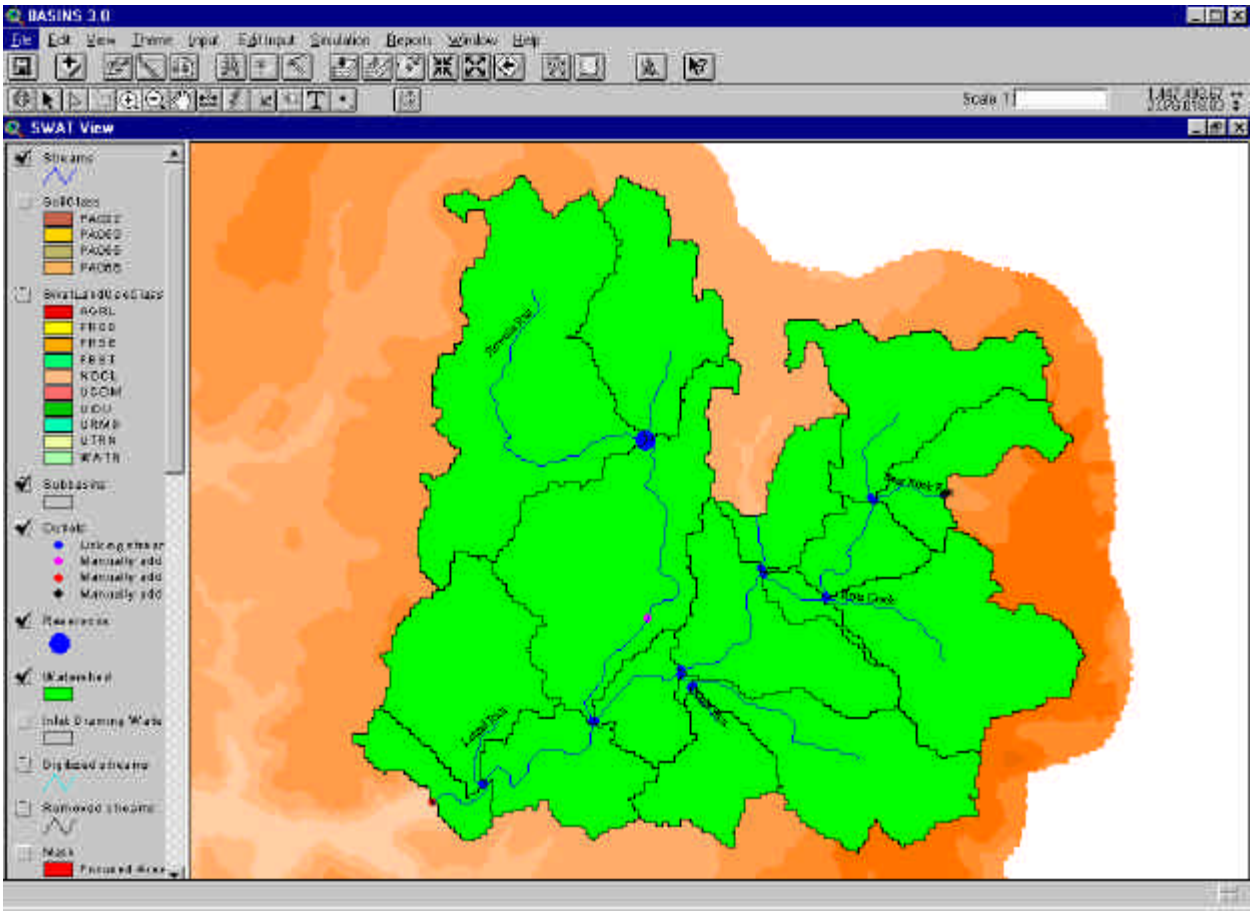
Screen 9.1.2.7

With the SWAT option and the BASINS *SWAT* extension loaded, automatically a new view (*Swat View*) is created, as a self closing message dialog shows (Screen 9.1.2.8)



Screen 9.1.2.8

The *Swat View* has a customized GUI in order to set up and run the SWAT model (Screen 9.1.2.9).



Screen 9.1.2.9

9.2 Land Use Reclassification

Purpose

BASINS Land Use Reclassification tool is used to group detailed land use classes, based on their code and descriptions, into broad categories. The land use reclassification tool can modify the existing land use theme(s) or create new themes with different classifications to reflect alternative scenarios.

Application

Reclassification of land use is often required to update existing land use data files, to group land use types, or to evaluate water quality impacts or management alternatives based on changes to land use over time. For example, changes in water quality due to urbanization can be accounted for by converting agricultural or forested land that is likely to be developed into an urban land classification. In addition, land use classes that have similar characteristics can be grouped into a single classification to simplify modeling. The main application of this tool is to support nonpoint source modeling.

Before you Get Started

First, verify that the Landuse Reclassify extension is active in your BASINS project by typing Ctrl+B from the BASINS view and selecting the **Utilities** item from the **Extension Categories** dropdown list. The Landuse Reclassify entry in the **Basins Extensions** list should be visible and selected. If the Landuse Reclassify is not selected (checked), click on it to select it.

Key Procedures

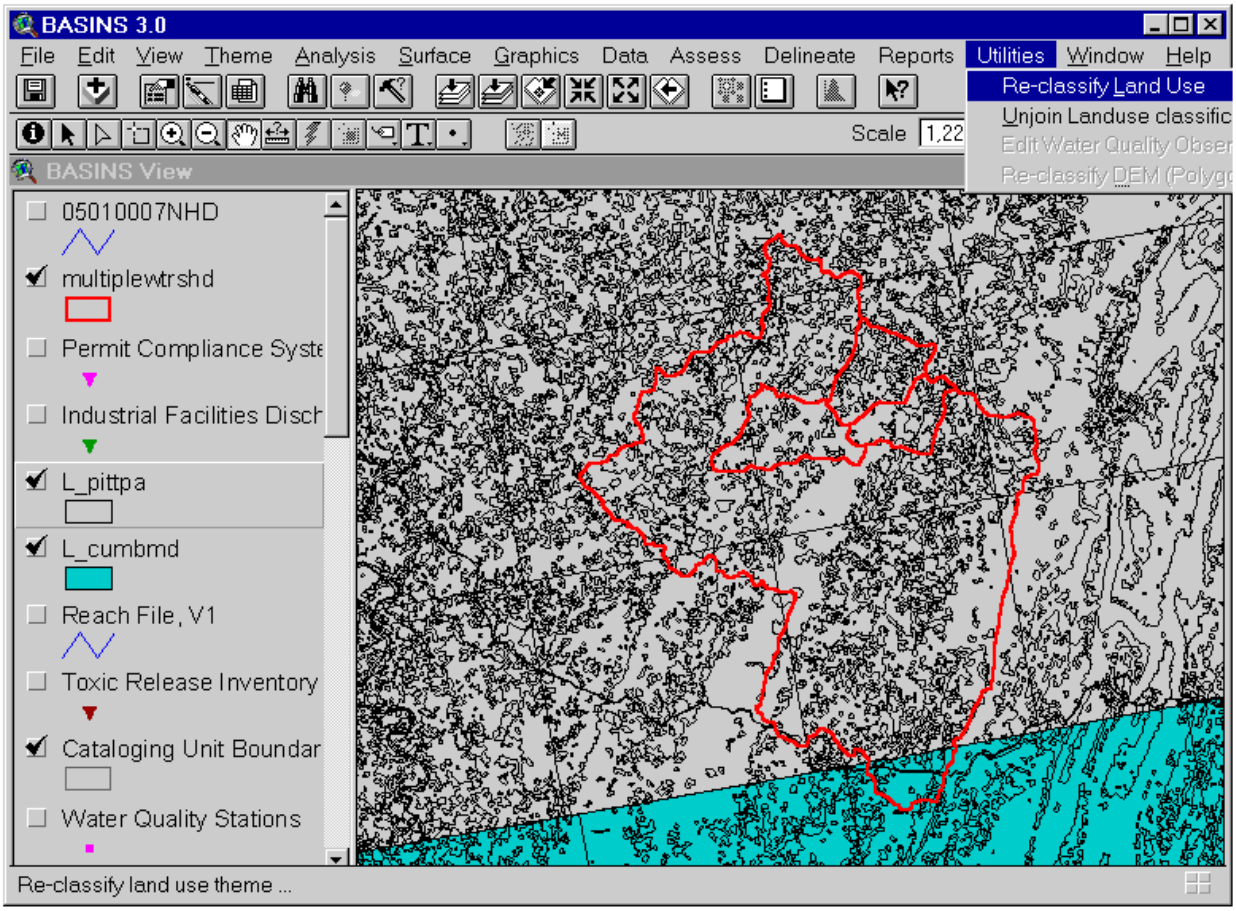
- Import land use using BASINS Import Land Use tool
- Activate the land use theme
- From the Utilities menu select Re-classify Land Use
- Select an existing land use code(s) to be reclassified
- Assign a new code and description

Detailed Operations Prior to being reclassified, a land use theme must be imported using the BASINS *Import Land Use* tool. This includes the existing BASINS land use themes included in the project. The BASINS land use theme data files must be copied, renamed, and then imported using the *Import Land Use* tool. The application and procedures for using BASINS *Import Land Use* tool are described in Section 7.2 of this manual.

Tip:	If the land use theme that is currently active has a scenario joined to it, you will be prompted to use the Unjoin Scenario tool first.

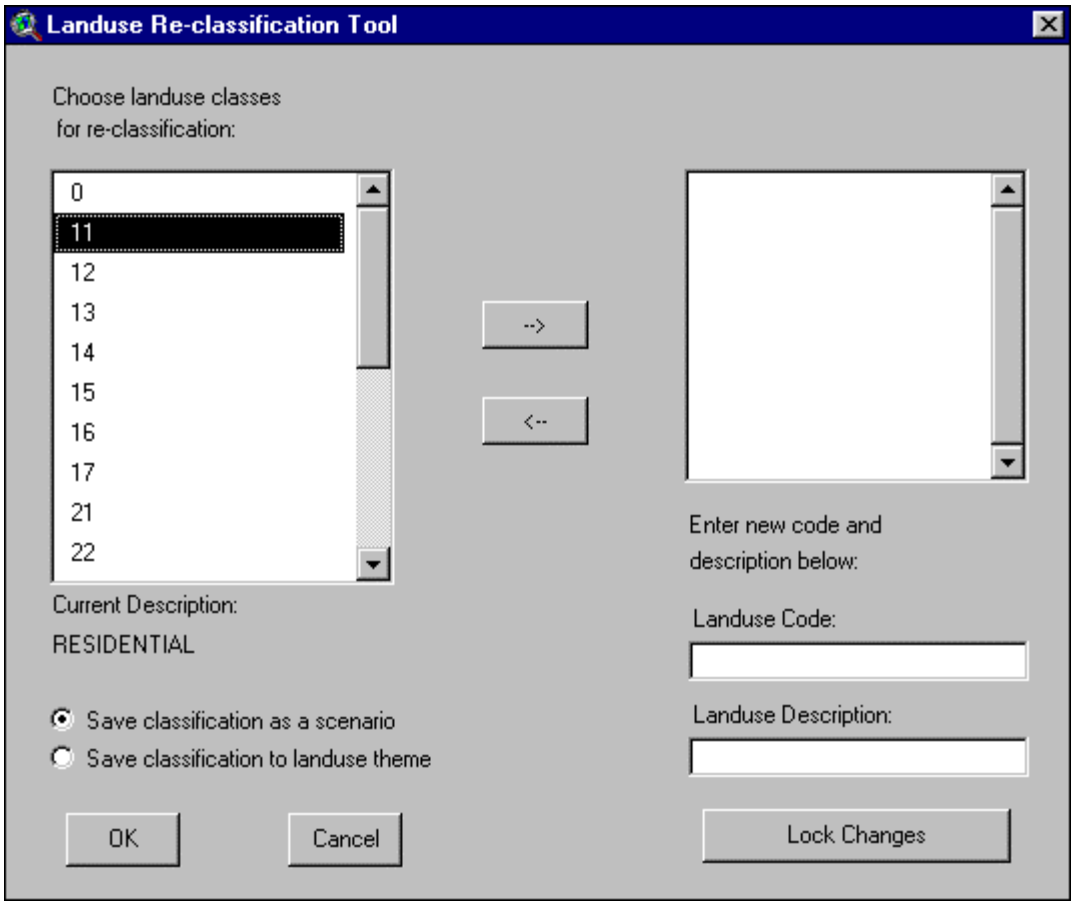
use the Unjoin Scenario tool first.

Activate the land use theme to be reclassified by clicking the cursor on the theme name. Check the box next to the theme name to display the theme on the BASINS View. From the Utilities menu, select “Re-classify Land Use” (Screen 9.2.1).



Screen 9.2.1

The reclassification dialog will appear on the screen (Screen 9.2.2). In the left box there will be a list of land use codes. These are the original land use codes. Click on one and its description will appear below the box. To add a land use code to a reclassified category select a code or multiple codes (hold Shift and click other codes for multiple selection), and then click the button with the arrow pointing to the right. The codes should appear in the right box. Below the right box are two text entry fields. Use the “landuse Code” field to enter a new numerical code for the codes listed above. In the “Landuse Description” field enter a new description for this new land use category. When finished with the current classification click on the *Lock Changes* button. The new code will reappear in the left box. If you click on the new code, the new description will appear below the left box.

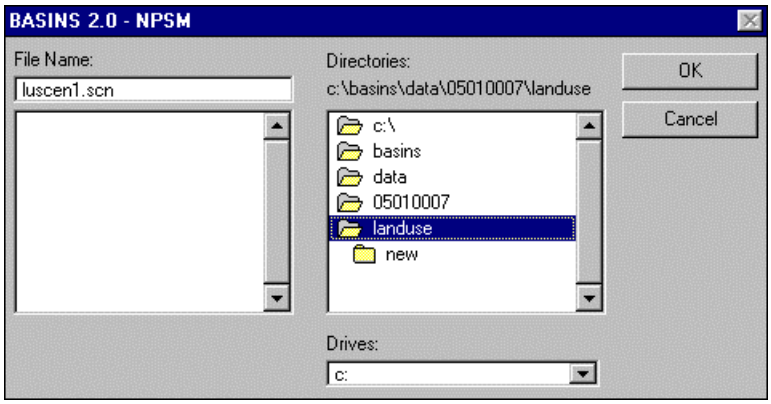


Screen 9.2.2

Tip: Once "Lock changes" has been clicked it is not possible to go back to the original classification unless you quit and begin again.

Repeat steps 4 through 6 until reclassification is complete. Below the left box are two radio buttons labeled "Save classification as a scenario" and "Save classification to land use theme". Select one of these options and Click *OK* button to save changes.

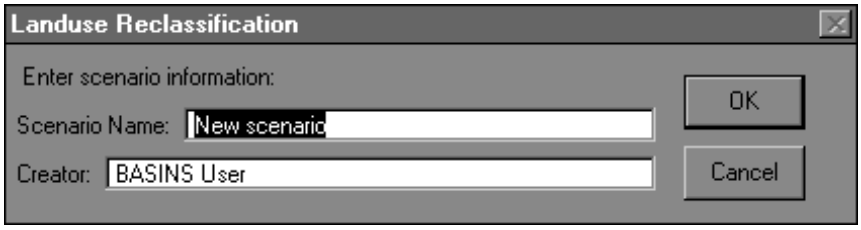
When the "Save classification to landuse theme" option is selected, the new classification is saved to the original attribute table. This option is not recommended if multiple scenarios will be considered. Selecting the "save classification as a scenario" option will save the reclassified landuse into a new database. This option allows the user to save multiple scenarios for an area without altering the original landuse information. When saving as a scenario you will be prompted to enter a filename (Screen 9.2.3). Enter a filename and click *OK*. The scenario file will be saved to a user selected directory. The file extension is .scn (for scenario). BASINS returns to the BASINS View. The classification changes may only be immediately noticeable if the "Save classification to landuse theme" option was exercised. If the "Save classification as a scenario" option was used then the changes will only be apparent when running *HSPF*.



Screen 9.2.3

Tip: The reclassification land use data will be used by HSPF but is not available for the *Land Use Distribution Report* function.

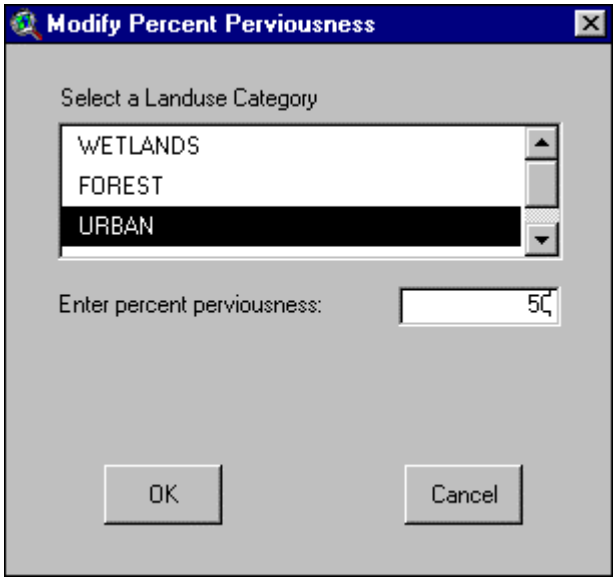
Enter scenario information in the next dialog box. (Screen 9.2.4)



Screen 9.2.4

Tip: Once the selected Land Uses have been reclassified, the HSPF model will need to be rerun to incorporate these changes into the model.

Modify the percent perviousness for each landuse if necessary (Screen 9.2.5). Click *OK* to save the changes and complete the reclassification.



Screen 9.2.5

TUTORIAL:

Activate the “Newlu.shp” Theme (do not select an area on the theme).

Select “Re-classify Land Use” from the Utility menu.

Select existing land uses 11 through 17 from the list by clicking on them one at a time (Screen 9.2.2).

Enter “10” for the New Land Use code.

Enter “Urban or Built-up” for the new description name.

Select “save classification as a scenario” and click *OK*.

Enter a file name for the scenario and save to the land use directory (Screen 9.2.3).

The new land use classification scenario file can be selected while executing HSPF from BASINS.

9.3 Water Quality Observation Data Management

Purpose

The *Water Quality Observation Data Management* tool can be used to access and manipulate the water quality observation database of the BASINS system. They can be used to add new stations to the database, delete unnecessary stations, relocate misplaced stations, and incorporate new water quality observation time-series data.

Application

The Water Quality Observation Station Management tools operate only on the water quality observation stations' primary attributes. A default point data layer of water quality stations was created from the USEPA STORET database. Only a limited set of stations was selected from STORET to be included in this layer. The selection criteria included the availability of sufficient time series of raw water quality observation data to allow for trend analysis and assessment of water quality conditions over time. Other considerations included the size of the overall water quality observation file and the need to obtain a balanced national coverage. With the station management tools, the user can enhance the station layer by updating the file and adding stations not included in the original file.

The Append Water Quality Observation Data utility can be used to add new water quality observation time series into the database for a given station. The basic database provided with BASINS is prepared from the USEPA STORET database and contains observation data for 106 parameters. The water quality observation data are collected by a number of organizations including individuals, contractors, universities, water laboratories, and federal, state, and interstate agencies.

Tip: The water quality observation data of a particular monitoring station are stored as a DBF file with a filename the same as the 8-digit (string) name of the cataloging unit where the station is located. The observation data for several monitoring stations within the same 8-digit watershed are stored in the same file. The DBF file is stored in the WQOBS subdirectory under BASINS\DATA\&LTProjectName&GT directory.

For this utility to function properly, the file that contains the new data to be appended should be in the correct format. A single file may include new data for several stations. The utility will ensure that the new data will be appended to the appropriate observation DBF files in the DATA\WQOBS directory.

By providing users the capability to add new water quality stations and update observation data, the BASINS data system can be enhanced and expanded to include more local data and therefore increase the usefulness of the system to state and local watersheds and water quality analysts.

Key Procedures **Water Quality Station Management Tools**

- Select the *BASINS extensions* submenu under the *File* menu

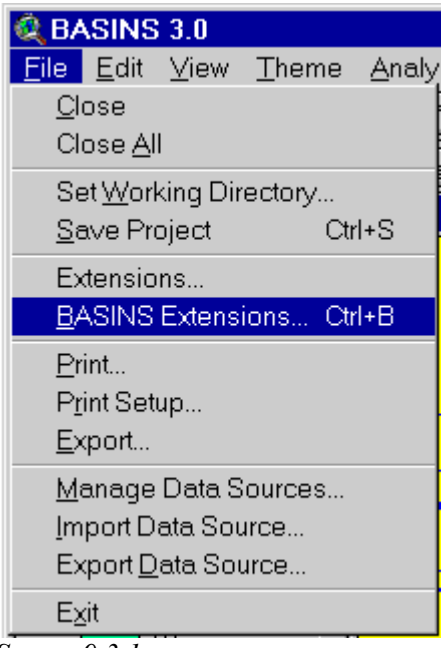
- Select “Utilities” as the extension category and check the *Wqobs Utility* extension
- Activate and check the check box of the Water Quality Observation Station theme
- Select the *Edit Water Quality Observation Station* submenu from the *Utilities* main menu to launch the Water Quality Observations toolbar
- Select the appropriate tool from the Water Quality Observations toolbar.
- Edit the geographical location or attribute data of the water quality monitoring station

Append Water Quality Observation Data

- Activate and check the check box of the Water Quality Observation Station theme
- Select the *Edit Water Quality Observation Station* submenu from the *Utilities* main menu to launch the Water Quality Observations toolbar
- Click on the **Append Data** button 
- Enter the filename of the file to append

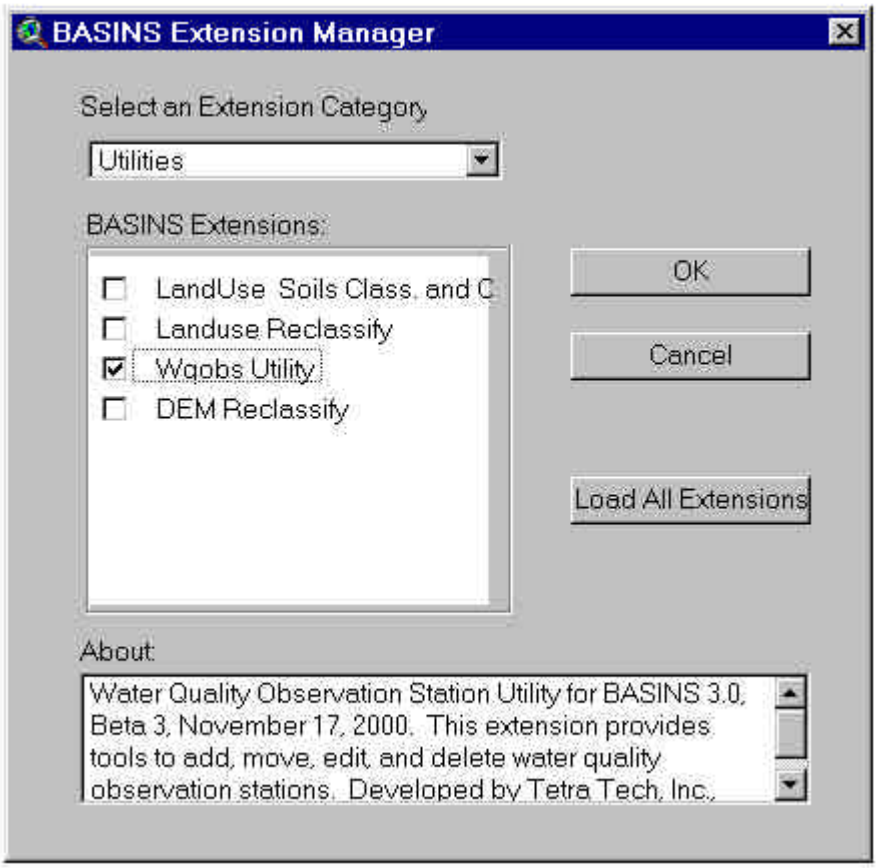
Detailed Operations

With BASINS View active, select the Basins Extensions... menu under the File menu (Screen 9.3.1).



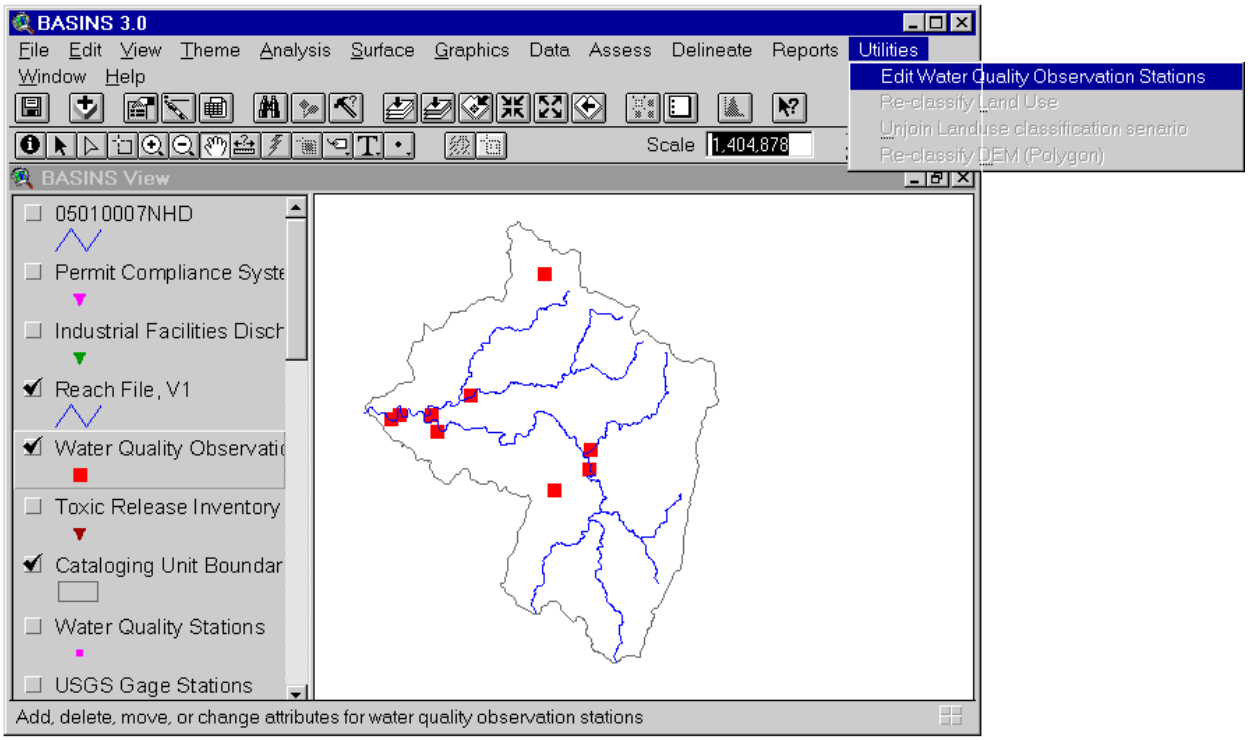
Screen 9.3.1

A “BASINS Extension Manager” dialog box will open. Select “Utilities” under “Select Extension Category”. Click “Wqobs Utility” as the BASINS extension (Screen 9.3.2). A small description of the extension is provided at the bottom of the dialog box. Click on *OK* when done. Note this will add a *Edit Water Quality Observation Station* submenu to the *Utilities* menu.



Screen 9.3.2

Adding New Water Quality Monitoring Stations In the BASINS View table of contents (Screen 9.3.3), click the name of the Water Quality Observation Station theme to make it active. Check its check box to display the point locations of the stations in the View window. This will activate the submenu *Edit Water Quality Observation Station* under *Utilities* menu.

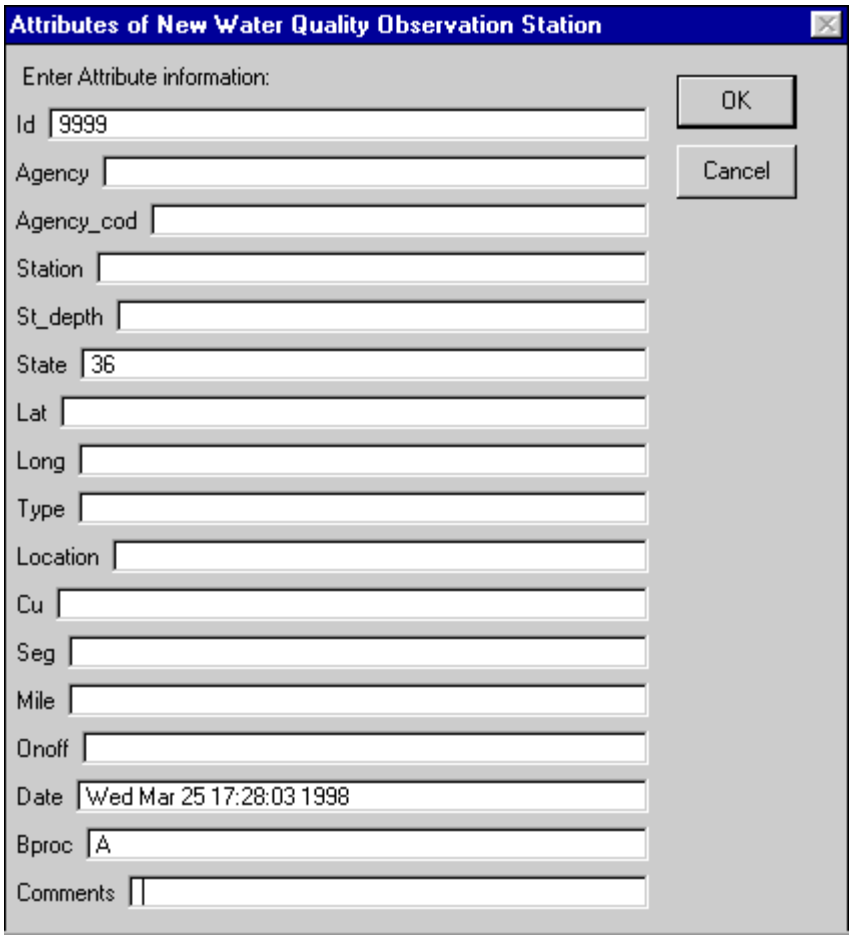


Screen 9.3.3

Click on the *Edit Water Quality Observation Station* submenu under the *Utilities* menu to launch the "Water Quality Observation Tools" toolbar (Screen 9.3.4).

Screen 9.3.4

From the "Water Quality Observations Toolbar" select the *Add Station* tool denoted by an "A". By using the mouse, click a point in the View window to indicate the location of the new station. In the pop-up table that appears, enter the primary attributes of the new station in the appropriate text fields. Initial values for some of the attributes such as the ID, state code, current date, and data processing code (Bproc field), are already provided in the pop-up table (Screen 9.3.5).



Screen 9.3.5

Click *OK* to save the new station and its attributes; otherwise, click *Cancel*.

Tip: When you are entering the primary attributes of the new station, all text fields in the pop-up table should be filled out to activate the *OK* button which will allow you to save the new station attributes. When no data are available for a particular text field, a space can be entered instead. Note that all text fields except for the Comments field and the other fields with predetermined values have already been initialized with a space.

Continue adding as many stations as needed. Otherwise, select another Water Quality Data Management Tool from the drop-down palette or another ArcView or BASINS tool to deactivate the *Add Station* tool.

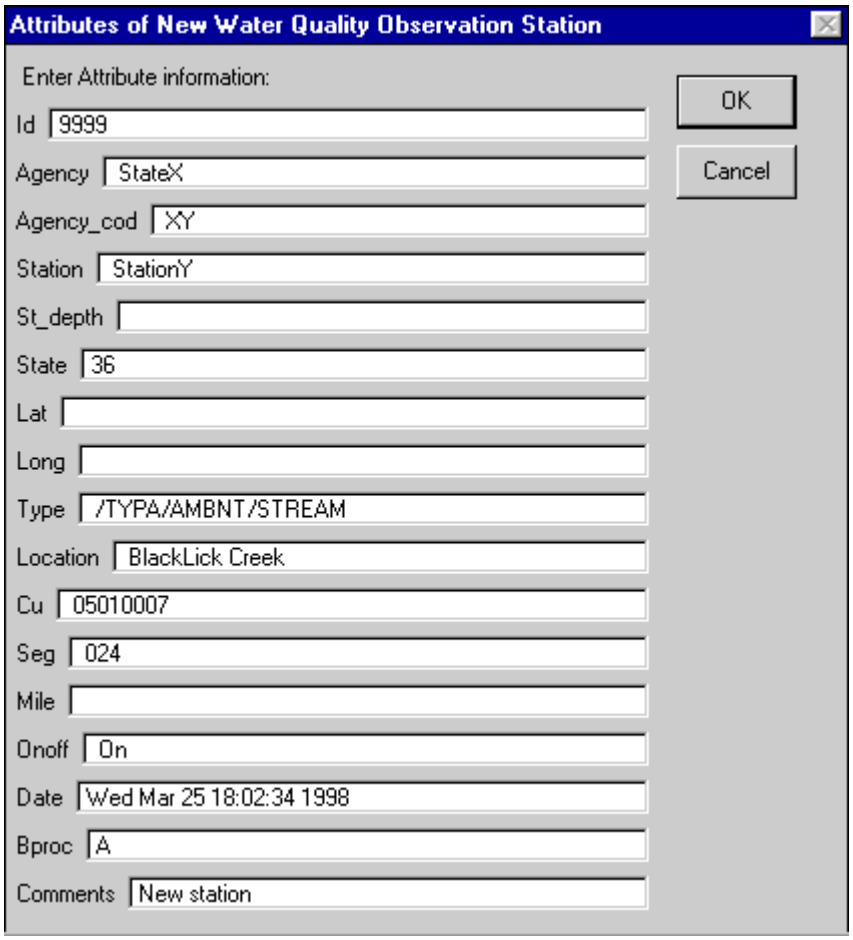
TUTORIAL:

Click the theme Water Quality Observation Station to make it active (Screen 9.3.3).

Check its check box to display the point locations of the observation stations in the View Window.

Select the *Add Station* button in the "Water Quality Observation Tools" bar (Screen 9.3.4).

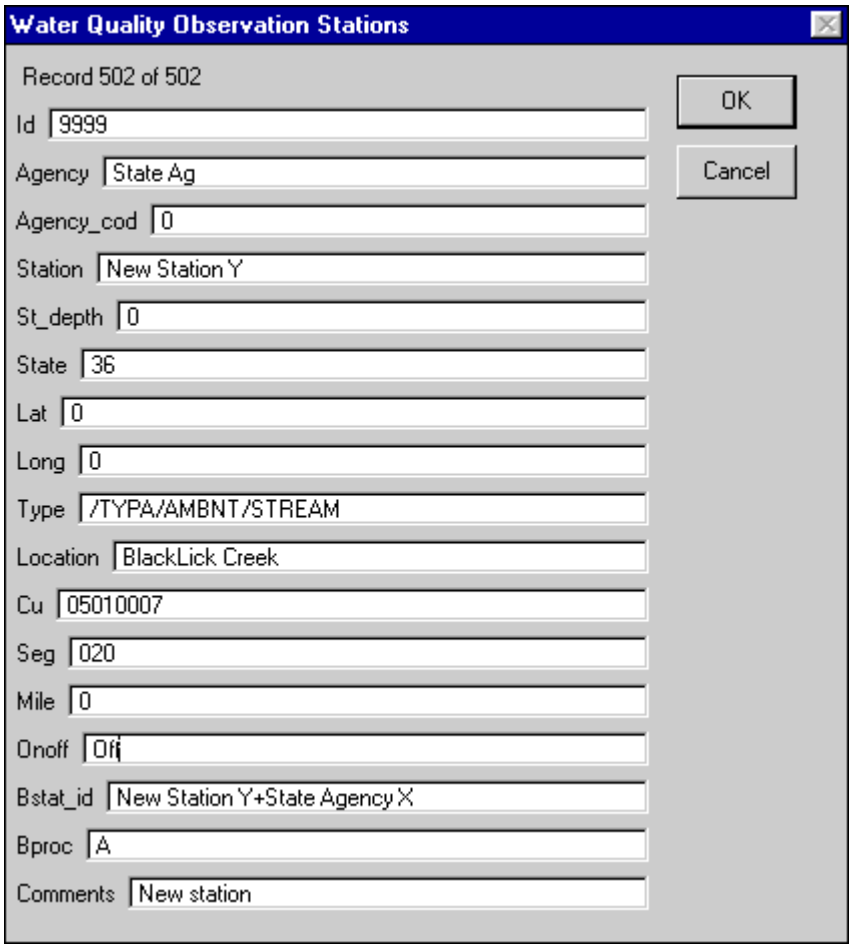
Using the mouse, click a point in the View window to add a new station. For this example, the new station was added at a point that has coordinates of X = 1,422,269 and Y = 2,089,066. Enter the values for the primary attributes of the new station in the pop-up table that appears. You may use the values shown in Screen 9.3.6. Note that initial values for some of the parameters are already initialized (Screen 9.3.5). Click *OK* to save the new station and its attributes. Note that the added station is now shown in the View Window.



Screen 9.3.6

Editing Primary Attributes of Existing Water Quality Monitoring Stations In the BASINS View table of contents (Screen 9.3.3), click the name of the Water Quality Observation Station theme to make it active. Check its check box to display the point locations of the stations in the View window. This will activate the submenu *Edit Water Quality Observation Station* under *Utilities* menu. Click on the *Edit*

Water Quality Observation Station submenu under the *Utilities* menu to launch the "Water Quality Observation Tools" toolbar (Screen 9.3.4). From the "Water Quality Observations Toolbar" select the *Edit Station* tool denoted by an "E". By using the mouse, select an existing station in the BASINS View window. In the pop-up table that appears (Screen 9.3.4), edit the primary attributes of the existing station as needed.



Screen 9.3.7

Click *OK* to save the new station and its attributes; otherwise, click *Cancel*.

Tip: The primary attributes of an existing station that contains no data (blank field) will cause the *OK* button of the pop-up table to remain inactive. If no new data are available to replace these blank fields, enter spaces instead to activate the *OK* button.

Continue editing as many stations as needed. Otherwise, select another Water Quality Data Management Tool from the drop-down palette or another ArcView or BASINS tool to deactivate the *Update Station* tool.

TUTORIAL:

Select the *Edit Station* button "E" in the "Water Quality Observation Tools" bar (Screen 9.3.4).

Select the station that you just added with the previous tool. A pop-up table that contains the primary attributes of this station appears. Note that it contains the attributes you entered with the previous tool.

You may now edit the attributes. You may use the values shown in Screen 9.3.7.

Click *OK* to save the edited attributes.

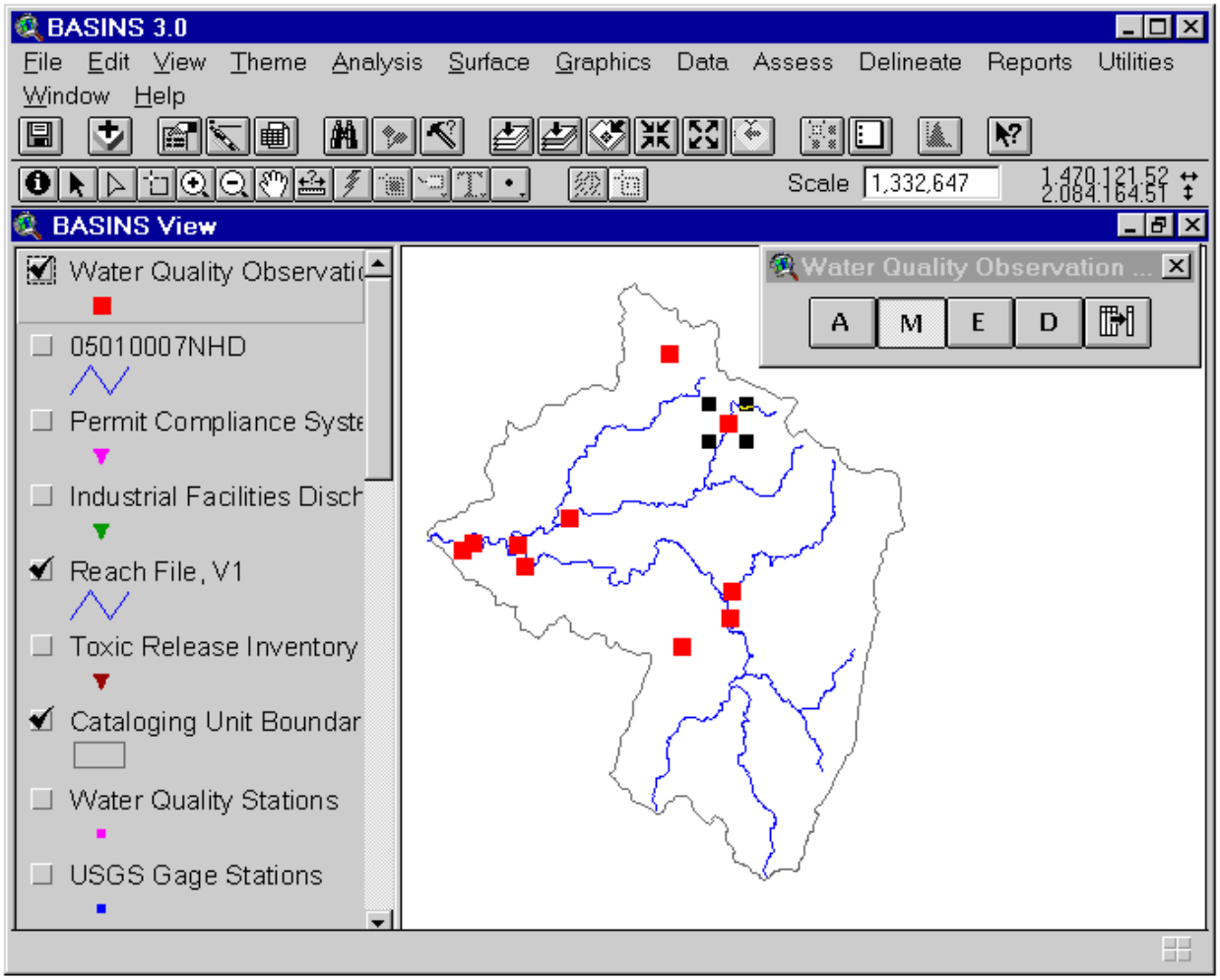
Moving (Updating Location) of Existing Water Quality Monitoring Stations In the BASINS View table of contents (Screen 9.3.3), click the name of the Water Quality Observation Station theme to make it active. Check its check box to display the point locations of the stations in the View window. This will activate the submenu *Edit Water Quality Observation Station* under *Utilities* menu. Click on the *Edit Water Quality Observation Station* submenu under the *Utilities* menu to launch the "Water Quality Observation Tools" toolbar (Screen 9.3.4). From the "Water Quality Observations Toolbar" select the *Move Station* tool denoted by an "M". By using the mouse, select an existing station in the BASINS View window. A place marker drawn around the selected station will indicate that the station is ready to be moved (Screen 9.3.5). Using the mouse, move or drag the station to the desired new location. In the dialog box that appears, click *Yes* to save the new location; otherwise, click No. Click *Cancel* if you want to continue dragging the same station to another location. Continue moving as many stations as needed. Otherwise, select another Water Quality Data Management Tool from the drop-down palette or another ArcView or BASINS tool to deactivate the *Move Station* tool.

TUTORIAL:

Select the *Move Station* button "M" in the "Water Quality Observation Tools" bar (Screen 9.3.4).

Select the new station that you added in the previous tool. A place marker around the selected station is drawn (Screen 9.3.8).

By holding the mouse down, drag the station to its new location, say just downsteam of the current location.



Screen 9.3.8

Deleting Existing Water Quality Monitoring Stations In the BASINS View table of contents (Screen 9.3.3), click the name of the Water Quality Observation Station theme to make it active. Check its check box to display the point locations of the stations in the View window. This will activate the submenu *Edit Water Quality Observation Station* under *Utilities* menu. Click on the *Edit Water Quality Observation Station* submenu under the *Utilities* menu to launch the "Water Quality Observation Tools" toolbar (Screen 9.3.4). From the "Water Quality Observations Toolbar" select the *Delet Station* tool denoted by an "D". By using the mouse, select an existing station in the View Window.

Tip:	Use *Delete Station* with caution since you might accidentally delete the wrong station, particularly when several stations are very close to one another. Use the ArcView Zoom tool to increase the resolution and clearly identify the station to be eliminated before you initiate the "*Delete Station*" process.

In the dialog box that appears, Click *Yes* to delete the station; otherwise, Click *No*.

Continue deleting as many stations as needed. Otherwise, select another water quality data management tool from the drop-down palette or another ArcView or BASINS tool to deactivate the *Delete Station* tool.

TUTORIAL:

Select the *Delete Station* button "D" in the "Water Quality Observation Tools" bar (Screen 9.3.4).

Use the ArcView Zoom tool to increase the resolution of the view and then select the station that you moved in the previous tool

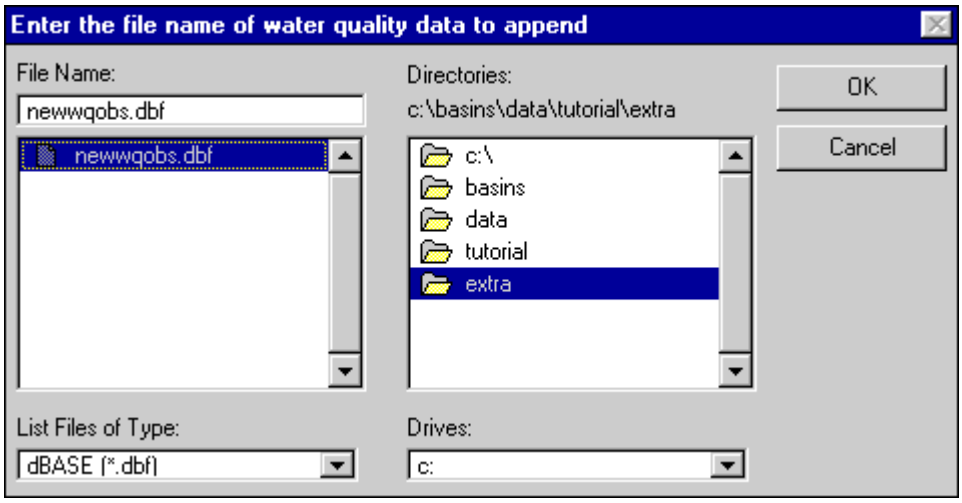
In the dialog box that appears, click *Yes* to delete the station.

At this point, your database should be back to its original form (that present just before you used the station management tools).

Append Water Quality Observation Data Utility In the BASINS View table of contents (Screen 9.3.3), click the name of the Water Quality Observation Station theme to make it active. Check its check box to display the point locations of the stations in the View window. This will activate the submenu *Edit Water Quality Observation Station* under *Utilities* menu. Click on the *Edit Water Quality Observation Station* submenu under the *Utilities* menu to launch the "Water Quality Observation Tools" toolbar (Screen 9.3.4). From the "Water Quality Observations Toolbar" select the *Append Data* tool

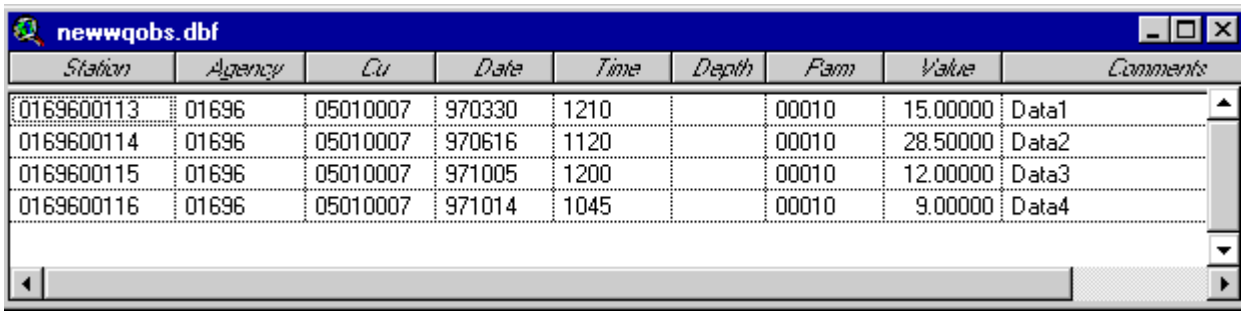
button.

In the file dialog box that appears (Screen 9.3.9), enter the name of the file that contains the new data to append. Click *OK* to append the file; otherwise, click *Cancel*.



Screen 9.3.9

Tip: The Append utility requires that the file to be appended be in the correct format. The new file should be in DBF format and must contain nine fields for the station name, agency, 8-digit cataloging unit code (CU) in character format, date, time, depth of measurement, STORET parameter character code (PARM), numeric value of the measurement, and any additional comments (Screen 9.3.10).



Station	Agency	Cu	Date	Time	Depth	Parm	Value	Comments
0169600113	01696	05010007	970330	1210		00010	15.00000	Data1
0169600114	01696	05010007	970616	1120		00010	28.50000	Data2
0169600115	01696	05010007	971005	1200		00010	12.00000	Data3
0169600116	01696	05010007	971014	1045		00010	9.00000	Data4

Screen 9.3.10

TUTORIAL:

Click the theme Water Quality Observation Station to make it active (Screen 9.3.3).

Check its check box to display the point locations of the observation stations in the View Window.

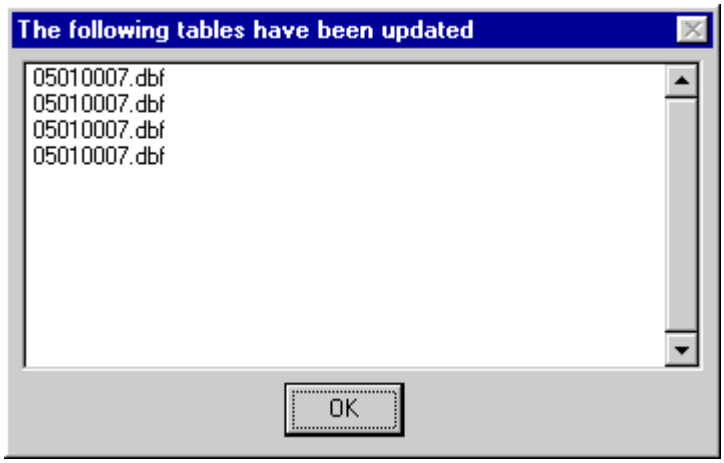
Select the Append Water Quality Observation Data button (Screen 9.3.4).

Enter the name of the file as shown in Screen 9.3.9 and click *OK* to append the file. The file to append

for this tutorial is saved in \BASINS\Data\Tutorial\Extra.

A pop-up table (Screen 9.3.11) will appear, confirming that the file has been appended to the appropriate BASINS DBF files.

Click *OK* to end the tool.



Screen 9.3.11

9.4 DEM Reclassification

Purpose

Digital elevation models (DEM polygon coverages) used in BASINS contain large amounts of spatially distributed information that cannot always be displayed in suitable detail. The *DEM Reclassification* tool allows a user to modify default color and interval schemes to display more detailed information based on the elevation features of selected areas, such as watersheds. A more detailed classification of selected areas within watersheds permits a more accurate delineation of subwatershed boundaries.

Application

This tool performs a topographic reclassification of the DEM coverage based on the elevation features of a selected watershed or area of interest within a watershed. A key feature is the ability to assign different numbers of classes to hilltop, middle basin, and valley areas depending on the watershed relief. This type of classification allows the user to focus the classification on key areas in the watershed. Potential applications of the *DEM Reclassification* tool include assisting in the watershed delineation process and providing more detailed elevation changes indicative of the severity of the relief.

Key Procedures

- Activate the DEM Polygon theme
- Zoom in and select the area of interest within a watershed
- From the Utility menu select the Re-classify DEM option
- In the BASINS DEM Classification dialog box, set your classification parameters
- Select a color scheme for DEM's legend

Detailed Operations Activate the DEM polygon theme by clicking on the theme name.

Tip:	If you did not extract a DEM polygon during data extraction, you will need to run extract again and add it to your database directory.

Zoom in and select the area of interest in the watershed.

Tip:	You can use the *Select Feature* tool or use the Select by Theme option under the Theme menu to select an area of interest on the DEM polygon theme. The DEM's reclassification will be based

on the elevation features of the selected area.

Tip: DEM data are tiled by watershed (8-digit Cataloging Unit) and therefore cannot operate on multiple watersheds.

Tip: *DEM Reclassification* operates on large amounts of data and therefore performs extensive processing. It is desirable to limit analysis to small watersheds. You can use the *Watershed Delineation* tool to define a subwatershed of interest and then apply *DEM Reclassification*.

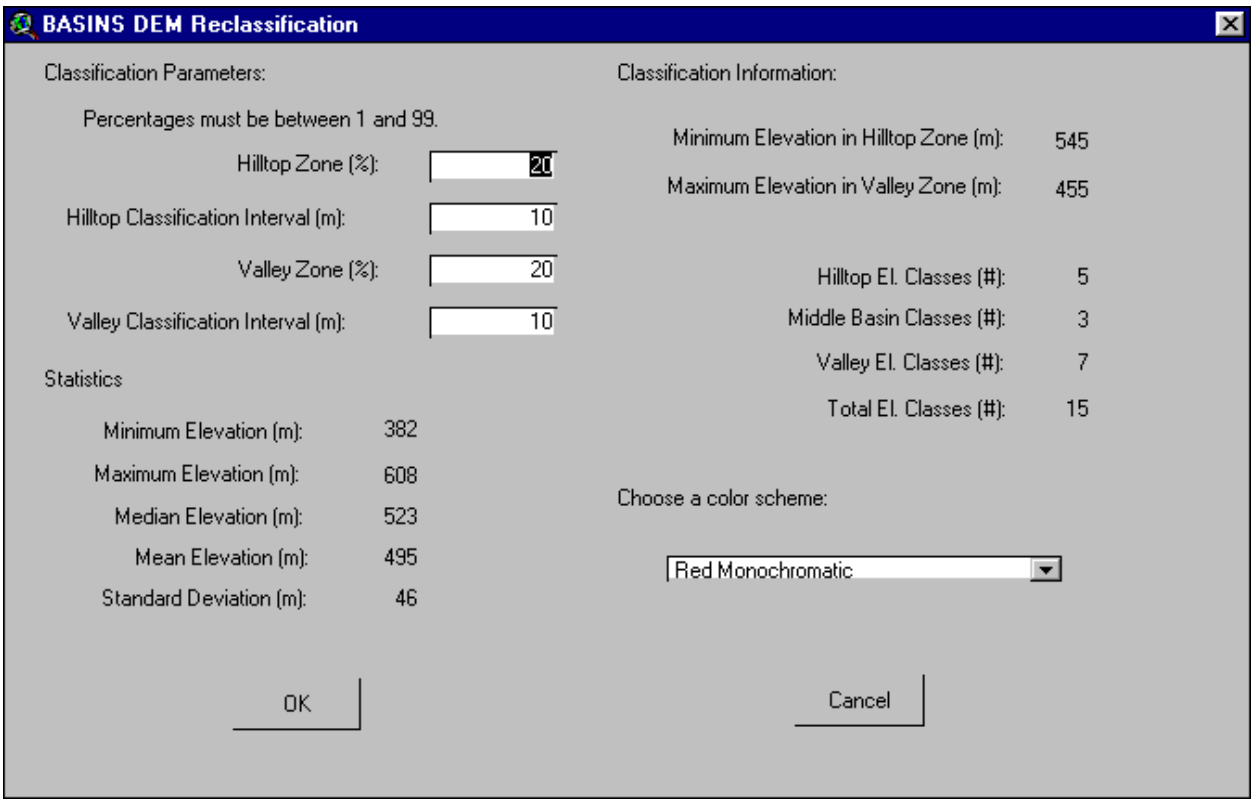
From the Utility menu, select the Re-classify DEM option. Assignment of classification parameters (Screen 9.4.1):

Hilltop Zone (%)	Sets the number of higher elevations, in terms of the percent of total elevations, to include in the hilltop zone. Select a small percentage to display a more detailed classification of higher elevations.
Hilltop Classification Interval (m)	Class interval for the hilltop elevations. Enter a small interval if you want to see a more detailed classification in hilltop areas.
Valley Zone (%)	Sets the number of lower elevations, in terms of the percent of total elevations, to include in the valley zone. Select a small percentage to display a more detailed classification of lower elevations.
Valley Classification Interval (m)	Class interval for valley elevations. Enter a small interval if you want to see a more detailed classification in valley areas.

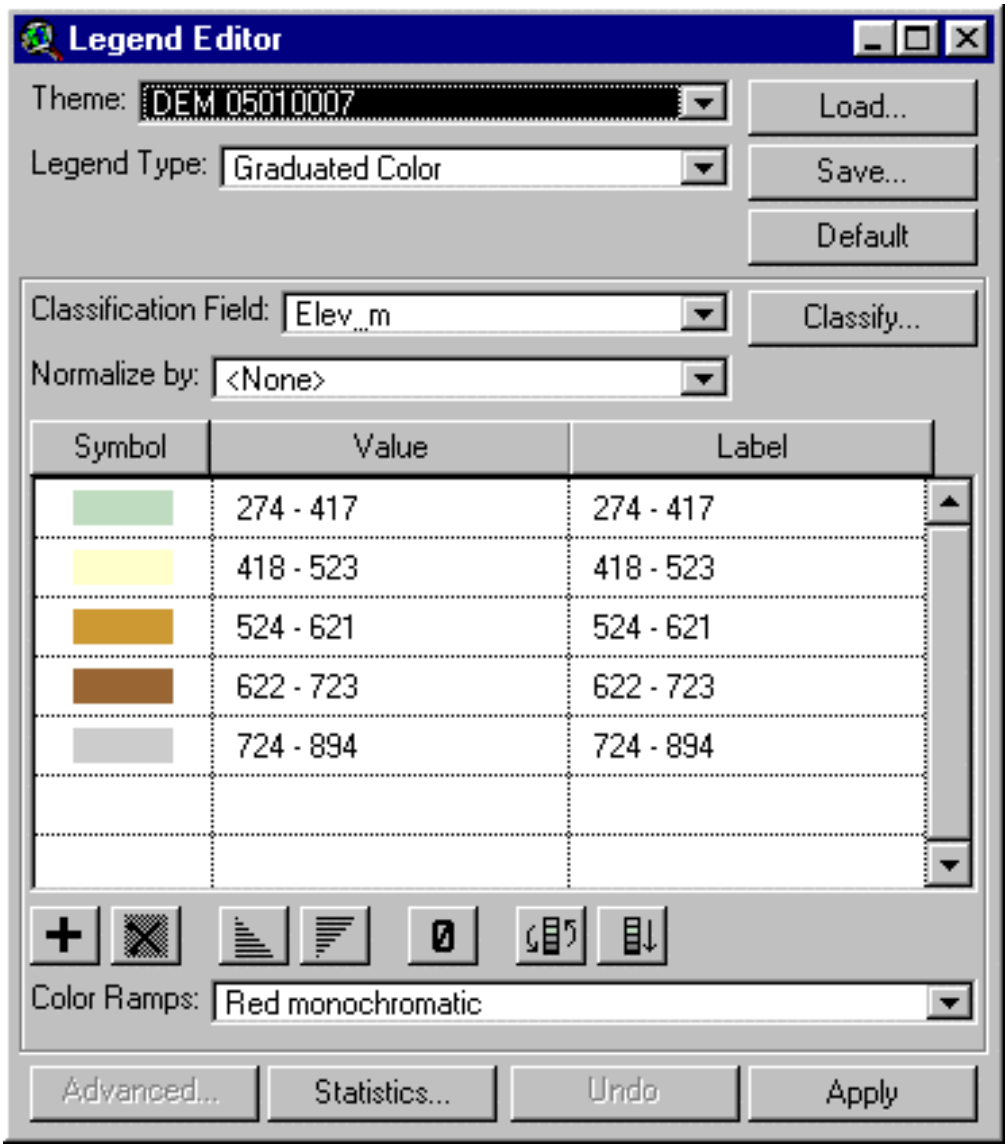
After you set the classification parameters, the maximum, minimum, median, and mean elevation, as well as standard deviation statistics for the selected area, are displayed in the lower left corner of the dialog box. Classification information is summarized in the top right corner of the dialog box. A suitable classification scheme may require a few attempts at classification parameter selection. Select a color scheme for the legend of the DEM polygon theme from the drop-down list in the lower right corner of the dialog box. Click *OK* to finish *DEM Reclassification*.

Tip: To change the color scheme without changing the classification after the *DEM Reclassification* is finished, select the Edit Legend option under the Theme menu or double-click on the legend of the DEM theme to open the Legend Editor (Screen 9.4.2). Choose another color scheme from the

Color Ramps drop-down list.



Screen 9.4.1



Screen 9.4.2

TUTORIAL:

Activate the DEM 05010007 theme.

Zoom in on the watershed.shp theme.

Select an area encompassing the three subwatersheds in the watershed.shp theme.

From the Utility menu, select Re-classify DEM.

Assign a value of 20 to “Hilltop Zone”, 10 to “Hilltop Classification Interval”, 20 to “Valley Zone”, and

10 to “Valley Classification Interval”. Select the Red Monochromatic color scheme. Click *OK*. Note that the entire DEM 05010007 theme is reclassified to better represent your selected area.